Interdisciplinary provision in higher education

Higher Education Academy

TRANSFORMING TEACHING
INSPIRING LEARNING

Interdisciplinary provision in higher education

Current and future challenges

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In partnership with the University of Edinburgh

Contents

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Team responsibilities

Catherine Lyall managed the project and led in drafting the final report. Laura Meagher was responsible for the two main surveys, conducted al l of the interviews and produced all of the case studies. Justyna Bandola provided the literature review and was responsible for the additional online surveys. Ann Kettle carried out all of the document analysis required for the identification of the programme director sample and the construction of the survey database.

All four team members commented on the final report.

Jessica Meagher provided additional project assistance.

Executive summary

Context and approach

Is interdisciplinarity the new zeitgeist for higher education (HE)? Recognition of the need for interdisciplinary research to address global, societal challenges is accelerating. Policymakers and non-governmental organisations frequently call for an evidence base that integrates social, cultural and economic dimensions with the natural and medical sciences.

At the same time, there is clearly pressure on higher education providers for increased emphasis on graduate employability to justify the investment in higher fees, which has led to an increased focus on the practical application of learning. This employability agenda accentuates the desire for agile learners who can utilise their graduate skills rather than simply accrue knowledge. This may result in trends towards competency-based education, enquiry-based learning and individualised student learning pathways and a sense that the needs of contemporary graduates no longer fit traditional institutional structures.

This evolving landscape generates new demands for global citizens and future employees who have the skills to work in multi-professional teams and adopt holistic approaches to complex problems, but higher education largely remains structured on a conventional, disciplinary basis. While disciplines will continue to underpin the foundations of our knowledge, the issue of interdisciplinary learning and teaching provision becomes increasingly relevant for institutions preparing students for a changing world.

It was within this context that the Higher Education Academy (HEA) commissioned a short study to deliver:

- a review of the literature about the effectiveness of interdisciplinary provision and the pedagogies which provide distinctive opportunities for interdisciplinarity;
- the results of a survey indicating the scale of current and likely future interdisciplinary provision;
- case studies of effective approaches to promoting, evaluating and sustaining interdisciplinarity;
- a set of principles that would underpin the development of interdisciplinary education.

This study adopted a mixed methods approach comprising a literature review of pedagogy related to interdisciplinarity; document analysis to identify a sample of current interdisciplinary programmes; online surveys of (i) directors of these interdisciplinary programmes, (ii) university leaders at the Pro-Vice-Chancellor (PVC) level, and (iii) other online Jisc communities; an administered survey at an HEA enhancement event in Belfast ('the Belfast conference group'); and semi-structured interviews with university leaders and programme directors from a range of higher education institutions (HEIs). From these, six case studies were developed, selected purposively to illustrate a range of types of interdisciplinary offerings and the processes of programme development.

Key findings

Provision and pedagogies: opportunities for interdisciplinarity

The term 'interdisciplinarity' is often contested and it may seem that there are as many definitions of its nature and purpose as there are commentators. In particular, the phrase 'integrative learning' is often used as an umbrella term for activities that bridge, for example, experiences inside and outside the classroom, theory and practice, and disciplines and fields while interdisciplinary studies is a subset of integrative learning. Truly interdisciplinary models restructure the curriculum with explicitly integrative activities that are typically theme-based, problem-based, or question-based, and organised within a curriculum that has a spine of required core courses ensuring attention is paid to interdisciplinary theory, concepts and methods (Klein 2005).

With this in mind, three common themes emerge from the academic literature on interdisciplinary learning and teaching:

- case studies presenting implementation of interdisciplinary teaching projects;
- analyses of the outcomes and challenges of interdisciplinary education;
- discussions of the socio-cultural context of interdisciplinarity.

The literature identifies a number of key drivers for interdisciplinary learning and teaching:

- individual-level drivers – such as personal connections between academics;
- university-level drivers – such as university strategy or regulations;
- external drivers – such as availability of funding or the requirements of professional bodies;
- socio-cultural and economic drivers – such as trends in education and workforce requirements;
- the nature or evolution of new disciplines – such as neuroscience, synthetic biology, law, environmental studies.

The scale of interdisciplinary provision indicated in the literature ranges from single workshops and courses to undergraduate and postgraduate degree programmes.

Even though interdisciplinary courses, modules and programmes are conducted at every level of university education, their goals and planned outcomes are diverse. As our own empirical data confirm, the literature indicates that interdisciplinary programmes and courses are most commonly (but not exclusively) available at the postgraduate taught (PGT) level or during the senior years of undergraduate (UG) education. However, the literature is not unequivocal with regards to the best locus of interdisciplinary education, especially regarding the timing of the first interdisciplinary course in a student's university experience.

Based on our analysis of the literature, we define three categories of teaching strategies that are variously termed 'interdisciplinary': co-teaching, interactive methods, and programme-level strategies.

Scale of interdisciplinary provision: results from surveys and interviews

Likely institutional trends in interdisciplinary education

Across all respondents to our surveys, most feel that the level of interdisciplinary educational provision has increased at their institution over the past five years (Chart A), although a significant proportion believe that the level is unchanged. Programme directors are more likely to report this increase than institutional leaders/PVCs.

Looking to the future of interdisciplinary educational provision at their institution over the next five years, most respondents expect the level to increase (Chart B). Programme directors envisioned a much higher proportion of interdisciplinary education in five years' time at both undergraduate and postgraduate levels than did academic leaders.

There are, nevertheless, differences in the views expressed by classes of respondents indicating variation in understanding of the demands for interdisciplinary learning and teaching. Perhaps the most striking differences between PVC and programme director responses lie in the latter's' generally greater expectations for postgraduate interdisciplinary education (taught or research), and far lower expectation for interdisciplinarity in professional/vocational courses.

Chart A: Change in interdisciplinary provision in past five years (*n* = 112)

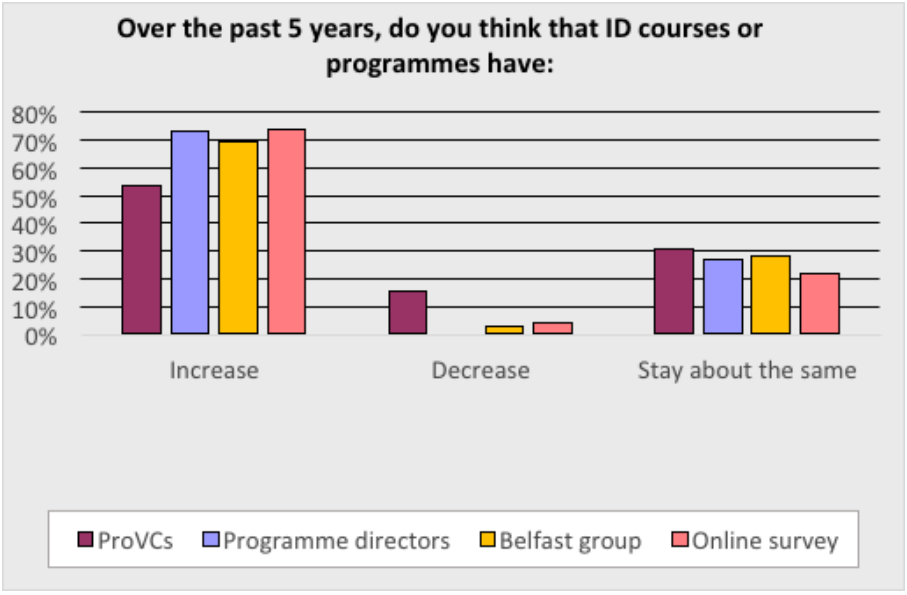
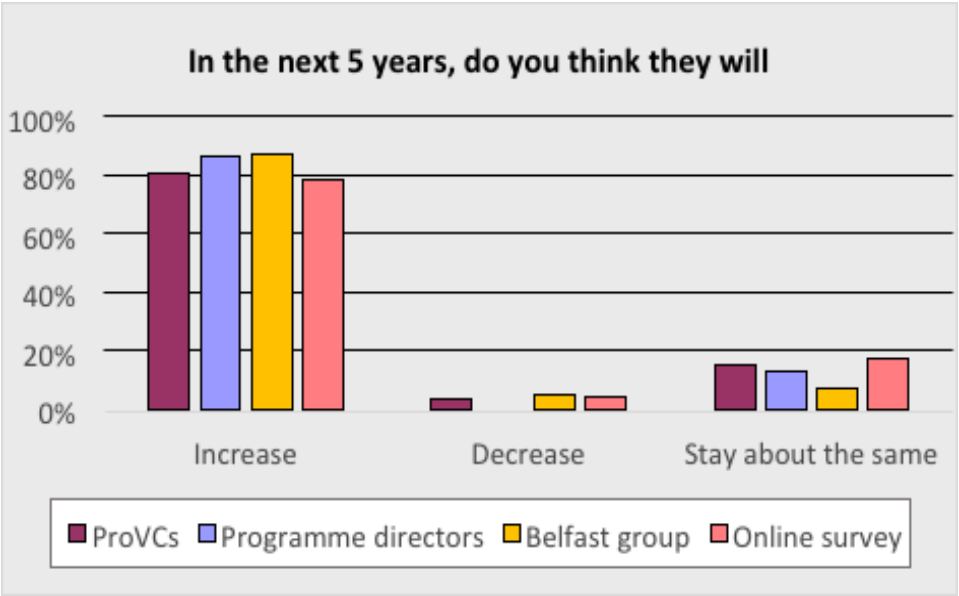


Chart B: Expected change in interdisciplinary provision in next five years (*n* = 112)



Institutional context and current provision

Interdisciplinary learning and teaching is an explicit component of many institutional strategies. It is a 'live' topic at the leadership level within HEIs where nearly three-quarters of PVC respondents report engaging in these discussions and one third report an increase in proposals for interdisciplinary programmes (not simply modules). This overall awareness of institutional context and provision is somewhat less evident at the level of the individual academic.

When asked about current interdisciplinary provision, nearly half of PVC respondents estimate that their institutions have more than five interdisciplinary undergraduate programmes and a quarter claimed more than ten. Shifting the focus to PGT, almost half of the same group again estimated more than five programmes. However, this time only 15% estimated more than ten, and a quarter of

these PVC respondents replied that there are *no* explicitly interdisciplinary taught postgraduate degree programmes at their institution.

Drivers

There were marked differences in perspectives regarding the drivers for interdisciplinary provision with university leaders highlighting professional/vocational needs and graduate employability while academics at the level of programme director predominantly identify championing by individual academics and the need to align teaching with complex societal issues as the main drivers. About half of each group identifies alignment with research directions.

Scope of interdisciplinary provision

The 'scope' of current interdisciplinary provision in terms of academic areas bridged suggests that this is predominantly an activity encompassing Arts, Humanities and Social Sciences although other combinations do certainly occur.

Pedagogy

Interdisciplinary education was seen to manifest itself in a range of pedagogical activities, although what is termed 'interdisciplinary' education is not necessarily integrated throughout every aspect of a programme and we find mixed views among our respondents as to whether provision labelled 'interdisciplinary' is, in actuality, an aggregate of different pre-existing modules from different courses, with only one or two new modules designed to be integrative. Interdisciplinary competences gained by students were variously identified as an ability to synthesise, appreciation of diverse perspectives, and flexible, critical thinking.

Challenges

The degree of challenge in effecting this type of culture change is indicated by the fact that nearly three-quarters of programme director respondents agreed that most academic staff simply wish to teach their usual modules in familiar subjects and not become involved in synthesis. Opinion was almost equally divided on the extent to which it was primarily the student's responsibility to integrate the various contributions of different teachers/modules in an 'interdisciplinary' programme. Assessment was clearly a particular challenge for interdisciplinary programmes as were various administrative problems such as the logistics of timetabling and resource allocation, not least the equitable distribution of teaching 'credit'.

Opportunities and advantages

Opinion was equally divided among programme director respondents as to whether their institution was likely to reward their leadership of an interdisciplinary educational programme. Yet, nearly all agree that they and colleagues feel a 'sense of excitement' when teaching an interdisciplinary programme; new thinking has been stimulated and research activity has been influenced. As well as the intellectual benefits for students, respondents commented on increased employability.

Professional capacity-building

Finally, we explored the extent to which academics, academic development staff, and academic leaders are prepared for such changes. There was near unanimity among all respondents that access to a body of good practice in interdisciplinary provision would be beneficial, but this contrasts sharply with current reality where, for example, only a quarter of programme director respondents and a third of PVC respondents said that their institution's staff development support explicitly included interdisciplinary teaching.

Effective approaches to promoting, evaluating and sustaining interdisciplinarity: case studies

Drawing on our interview data, we provide six case studies of effective approaches to promoting, evaluating and sustaining interdisciplinarity. The experiences captured span:

- an innovative extracurricular experience in interdisciplinary project teams;
- piloting an interdisciplinary module;
- a new interdisciplinary undergraduate degree programme;
- a professional education PGT Masters' degree;
- a liberal arts undergraduate programme bridging arts and sciences with a major, a minor, and interdisciplinary core modules;
- an example of top-level, institutionalised support for interdisciplinary undergraduate education at a major US university.

Principles for the development of interdisciplinary education: conclusions to our study

While compulsory interdisciplinary courses may have become a standard feature of the curriculum in the US, the same is not yet true in the UK, but interdisciplinary learning and teaching is, nevertheless, an explicit component of many institutional strategies.

Curriculum enhancement ambitions are becoming more widespread in the UK with many universities seeking to combine academic excellence with a greater focus on, *inter alia*, skills such as critical thinking and effective communication, engendering openness to more reflexive learning and personal development, and preparing students for global citizenship. However, curriculum enhancement and a more integrated approach to learning do not necessarily constitute 'interdisciplinarity' and the pedagogical approaches included in some descriptions of 'interdisciplinary' provision are not unique to interdisciplinarity.

Our findings show a range of activities taking place at different scales – at the level of one-off workshops, single course modules or units or, sometimes, full degree programmes. These activities have different (and not always fully articulated) aims, whether these manifest as a general awareness of knowledge beyond the student's immediate degree discipline, an ability to go further and apply that knowledge, or a more root-and-branch transformation of the student's way of thinking and viewing the world.

We have synthesised a set of pedagogical techniques (see Table 1) that are discussed in the literature within the context of effective practice in interdisciplinary learning and teaching. While there is recognition that "interdisciplinary teaching and learning requires a host of powerful pedagogies" (DeZure 2010, p. 384), commentators also stress that there "is no unique or single pedagogy for integrative interdisciplinary learning" (Klein 2010, p. 9).

Table 1: Synthesis of interdisciplinary teaching strategies and pedagogical techniques	
Strategy	**Pedagogical techniques**
Co-teaching	> Advanced planning and negotiation with co-teacher > Co-advising with industry representatives > Taking turns in teaching > Creating learning community > Co-creation of syllabus and case studies
Interactive methods[1]	> Project-based learning (PBL) > Case study methods > Role-playing > Simulations > Virtual methods > Peer-assessment and review > Peer-assisted learning (PAL) > Small-group teaching
Programme-level strategies	> Interdisciplinary electives > Core courses covering material from different perspectives > Research conducted for the initial stages of graduate school

What is largely missing from literature and from the empirical data we have collected, is a debate about, or evidence for, the underlying "curriculum ideologies" (Toohey 1999, p. 45) – the principles, ideas, beliefs and epistemologies that might underpin interdisciplinary learning and teaching. We suggest that theory has not yet caught up with practice in this field and there is a clear lack of theorising about pedagogy in this emerging area of learning and teaching practice.

Although the most obvious drivers for increasing interdisciplinarity may be instrumental (e.g. perceived new income streams, improved graduate employability), the issue of interdisciplinary provision points to the heart of how universities are organised and the purpose of higher education. A key unanswered question raised by our study is whether interdisciplinarity is evolving within universities or whether universities are, themselves, evolving.

Our findings highlight the role of the committed, entrepreneurial academic as a key driver, and the fact that interdisciplinary teaching is often an activity that takes place at the margins of mainstream teaching. This is a risky strategy for the sustainability of interdisciplinary learning and teaching: if it is not to rely solely on the efforts of individual champions, greater institutionalisation will be necessary.

Recommendations regarding HEA's role in supporting interdisciplinary learning and teaching

We conclude that a successful interdisciplinary curriculum should be aimed at mitigating the institutional and personal challenges of interdisciplinarity on the one hand, and fulfilling specific learning objectives expected from interdisciplinary education on the other. We therefore identify three potential roles for HEA in supporting interdisciplinary learning and teaching.

Respondents call for access to a body of good practice in interdisciplinary provision, underscoring the importance of institutionalised support, for example, in university strategies, through institutional reforms or the inclusion of interdisciplinarity in Postgraduate certificate in higher education (PGCHE) provision. Access to research and good practice (for example, in the form of case studies) was

[1] Note that the interactive methods listed are not exclusive to interdisciplinary provision.

emphasised, as were skills-development training, for example, through organisation of masterclasses (see e.g. Lyall and Meagher 2012), or through funding for trials and test projects.

First, a significant role for HEA in supporting subscribing institutions may be to act as a respected forum where experiences of interdisciplinary learning and teaching can be developed and shared. There could be a role for HEA in supporting accessible external masterclasses to supplement academic development offerings available within institutions.

Secondly, in addition to this developmental support, HEA may wish to take the lead as a locus for defining a pedagogic research agenda for interdisciplinarity to underpin this important learning and teaching activity with the necessary theoretical understanding, which we currently find to be lacking.

Finally, HEA plays an important leadership role in the higher education sector. In supporting interdisciplinarity in undergraduate and postgraduate taught education, HEA may wish to encourage leaders of HEIs themselves to reflect upon the following underlying principles of interdisciplinary education:

1. If institutions are going to embark on a strategy of interdisciplinary learning and teaching, there must be clarity of purpose:
    a. institutions should recognise that, with no one all-purpose pedagogy for interdisciplinarity, they must articulate clearly their own goals and develop strategy accordingly;
    b. the potential for interdisciplinary education to add value to an institution and its outputs should be articulated clearly: to staff but also to students, parents, employers and other stakeholders;
    c. curriculum enhancement, integrative learning, and interdisciplinary learning and teaching represent different goals and require staff and students to develop different sets of well-aligned competences in learning and teaching.
2. If institutions are to develop effective interdisciplinary learning and teaching, this requires a whole institution approach in order to overcome the many academic and administrative barriers that exist:
    a. some of these barriers may be perceived rather than real but it will require a concerted process of institutional change to overcome both the misperceptions and the realities;
    b. not all institutions, nor indeed every part of each individual institution, will embrace interdisciplinarity; this is reasonable in a healthily diverse higher education system. However, for those institutions seeking excellence in interdisciplinary education, advocacy, facilitation, celebration and reward will be key;
    c. in promotion and other professional assessments, recognition must be clearly available for interdisciplinary activity relevant to education (e.g. teaching, mentoring, and development of new courses and related research).
3. Successful interdisciplinary learning and teaching is resource intensive:
    a. the development of a coherent interdisciplinary course takes time, if it is not to rely on students to do the integration. This needs to be recognised, for example, in models of workload allocation;
    b. for some universities this will require considerable culture change if staff are to be adequately trained, supported and rewarded. Skills development should be facilitated in academics taking on the challenge of effective interdisciplinary teaching. This training might take various forms, whether in-house or external short courses or expert masterclasses;
    c. various other forms of support may be required, ranging from institutional advocacy to seed corn funding for course development, to administrative matters such as scheduling and credit sharing across departments. Pioneering academics should be facilitated to share their own learning about good practices within their own institutions and across the sector.

1. Introduction

Is interdisciplinarity the new zeitgeist for higher education? As Graff (2015) notes, the term is both ubiquitous and contested in the scholarly literature[2]. Recognition of the need for interdisciplinary research to address global, societal challenges is accelerating. Policymakers and non-governmental organisations frequently call for an evidence base that integrates social, cultural and economic dimensions with the natural and medical sciences (Lyall *et al.* 2011, Ch. 1).

This evolving landscape generates new demands for global citizens and future employees who have the skills to work in multi-professional teams and adopt holistic approaches to complex problems, but higher education largely remains structured on a conventional, disciplinary basis. While disciplines will continue to underpin the foundations of our knowledge, the issue of interdisciplinary provision becomes increasingly relevant for institutions preparing students for a changing world.

Bodies related to higher education, as well as institutions themselves, have taken up this issue. So, some 30 years after the Organisation for Economic Cooperation and Development (OECD) identified five drivers[3] for interdisciplinarity (OECD 1972), the United States National Academies (2005) called for growth of interdisciplinarity as a strand to be woven into both undergraduate and postgraduate education. The US National Science Foundation's Integrative Graduate Education and Research Traineeship (IGERT) programme was one response to that mandate.[4] Launched in 2007, the 'Melbourne Model' (Fearn 2009), is also now an oft-cited example of higher education curriculum reform that has stimulated interest in interdisciplinarity. Based on a broader undergraduate education followed by a graduate level professional specialisation[5] undergraduate students study 25% of their modules from outside their degree programme on so-called 'breadth subjects'. Despite mixed reviews (Potts 2012; Fearn 2009), this model has, nevertheless, proved influential with other universities seeking to update their curricula.[6] Innovative initiatives are thus being explored by universities in a variety of countries, including, for example, the University of Copenhagen's project on 'Cross-disciplinary education'[7], which is conducting pedagogical analyses of a set of multiple interdisciplinary pilots across the university, and the University of Amsterdam's Institute for Interdisciplinary Studies, which acts as a hub for understanding and developing interdisciplinary education (de Roo and van Gorp 2014).

In the UK, an analysis of Russell Group university strategic plans (Bandola and Lyall 2015), confirmed that virtually all such universities now mention 'interdisciplinarity', whether in the context of research, teaching or estate planning. However, notwithstanding a well-established focus on interdisciplinary research supported by Research Councils UK (RCUK),[8] reports emanating from a flagship cross-council investment, Living with Environmental Change, have called for greater interdisciplinary research skills and lament:

> Despite years of interdisciplinary rhetoric, it is still difficult to find people who are able to move easily between social and environmental sciences *(LWEC 2012).*

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[2] Definitions of the term 'interdisciplinarity' abound. A not unreasonable starting point might be Heckhausen's definition for the OECD (1972): "Interaction may range from simple communication of ideas to the mutual integration of organising concepts, methodology, procedures, epistemology, terminology, data, and organisation of research and education in a fairly large field."

[3] The development of science; student demand; the need for professional training; societal needs and the functioning of university administration (OECD 1972).

[4] www.igert.org

[5] For example, Law, Architecture, Teaching and Nursing.

[6] See, for example, the University of Aberdeen's slightly confusingly named 'Sixth Century Courses' www.abdn.ac.uk/study/about/sixth-century-courses-348.php or the University of Manchester's University College for Interdisciplinary Learning www.college.manchester.ac.uk

[7] www.ind.ku.dk/english/crossdisciplinarity/

[8] www.rcuk.ac.uk

This international context of change, within and beyond higher education institutions (HEIs), makes examination of interdisciplinary learning and teaching provision in the UK both timely and compelling.

Opinions differ on whether increasing trends towards more problem-focused research to tackle 'real world' issues will lead to the introduction of more interdisciplinary elements in degree programmes (Blackmore and Kandiko 2012) or whether the increased marketisation of higher education will turn the focus away from curriculum innovation and back towards traditional single-subject disciplines (Gibbs 2012). HEIs may see interdisciplinarity as an opportunity or as a threat depending on the institution: while some may be attracted by the marketability of interdisciplinary courses, many are slow to provide supporting structures to deliver interdisciplinary courses effectively (Chandramohan and Fallows 2009, pp. 160–1).

Nevertheless, there is clearly pressure on higher education providers for increased emphasis on graduate employability to justify the investment in higher fees, which has led to an increased focus on the practical application of learning. This employability agenda accentuates the desire for agile learners who can utilise their graduate skills rather than simply accrue knowledge. This may result in trends towards competency-based education, enquiry-based learning and individualised student learning pathways and a sense that the needs of contemporary graduates no longer fit traditional institutional structures. In tandem, an aspiration for education for sustainable development (QAA and HEA 2014) has shone a light on broadening the student experience.

As noted in the HEA's call for tenders for this study, interdisciplinarity poses a range of challenges to the sector. These include: the level of preparedness and skills of staff to undertake work outside of their area of disciplinary expertise; striking the balance between theory and practice (Strober 2011); avoiding disadvantaging students by exposing them to different disciplinary perspectives; the willingness of students to take modules outside the home department or familiar discipline (and possibly jeopardise their grades) and the challenge of assessing changed student perspectives as a result of interdisciplinary learning (Blackmore and Kandiko 2012).

These issues go to the heart of how universities are organised and the very purpose of higher education. Klein (2010a) chronicles the struggles of a number of US universities to sustain interdisciplinary studies programmes and highlights the tensions between the need for "normalisation" in order to gain strength and stability for such programmes versus "a mission for insurgency" aimed at unsettling conventional disciplinary practices (2010a, p. 123). Interdisciplinary undergraduate studies have made significant gains in US higher education but, paradoxically, these programmes have often failed to achieve a permanent position in the curricula of individual universities and colleges (Augsburg and Henry 2009). As Newell (2009) concludes, interdisciplinary studies programmes "are always at political risk" (2009, cited in Klein 2010a).

Interdisciplinarity should not, however, be seen as an end in itself, and we strongly support the view, promulgated by the Eighth Global Summit on Graduate Education,[9] that:

> Interdisciplinarity in graduate education and research must answer specific, identifiable needs. *(p. 3)*

1.1. Aims and objectives

The aims of this project were to:

1. provide a literature review of interdisciplinary provision both from a national and an international perspective;
2. map the scale and type of current interdisciplinary provision; to classify different forms of interdisciplinary provision; to identify plans for future expansion, steady state, or reduction.

[9] www.cgsnet.org/university-leaders-issue-statement-interdisciplinarity-graduate-education-and-research

In addressing these aims, this report brings together the empirical findings from a mixed methods study (Section 2) and seeks to answer the following research questions identified in the call for tender:

- What are the pedagogies that are likely to provide distinctive opportunities for interdisciplinarity?
- What are the key elements of effective practice that are identified within the literature?
- For which of these is there a robust evidence base evaluating the effectiveness of interdisciplinarity?
- What gaps exist in the existing literature in relation to: (a) types of disciplines that are not widely evaluated and for which there is a strong prima facie case that they are high impact; (b) the scope for the existing evidence bases to be further strengthened and developed?
- What are the principles supporting interdisciplinarity in undergraduate and postgraduate taught education?

Interdisciplinarity is often contested and it may seem that there are as many definitions of its nature and purpose as there are commentators.[10] The term 'interdisciplinary' is often used synonymously – and, we argue, erroneously – with 'multidisciplinary'. The literature review (Section 3) consciously avoids engaging in these extensive debates and instead focuses on understanding the effectiveness of interdisciplinary provision and promising pedagogies. The empirical data from our surveys and interviews (Section 4) provide a sense of the scale of UK provision and likely trends. Case studies, supported by survey and interview data, enrich these findings (Section 5).

In answering the above questions, we highlight not only tools and practices but also institutional approaches to addressing critical current and future challenges (Section 6). In doing so, we propose some principles for supporting interdisciplinarity in undergraduate and postgraduate taught education, drawing on the statement issued by the Eighth Global Summit on Graduate Education (Table 1.1).

Table 1.1: Statement from Eighth Global Summit on Graduate Education
Principles for supporting interdisciplinarity in (post)graduate[11] education and research
Participants in the 2014 Strategic Leaders Global Summit recommend that (post)graduate institutions consider the following principles when making decisions about interdisciplinarity in (post)graduate education and research: 1. Articulate the added value of interdisciplinary approaches and initiatives within institutional contexts. 2. Communicate and advocate for the value of interdisciplinary research and learning to the broader community. Education efforts should include not only the broad value of interdisciplinary research and learning, but also the specific relevance and benefits to each stakeholder group. 3. Identify and develop the skills (post)graduate students will need to engage effectively in interdisciplinary research collaborations or research projects throughout their careers. 4. Provide opportunities and spaces for (post)graduate students and faculty to meet colleagues in other disciplines, work on interdisciplinary research teams or on interdisciplinary research projects. 5. Build administrative bridges to encourage interdisciplinary research and learning. Where existing structures inhibit cross-disciplinary collaborations, find ways to remove barriers and

[10] In 2007, Angelique Chettiparamb's study provided the HEA with an overview of the concept of interdisciplinarity and its implications for teaching and it is not our purpose to replicate that study. The Chettiparamb study was part of a project funded by the HEA, the Interdisciplinary Teaching and Learning Group set up in 2005 to explore all facets of interdisciplinary teaching and learning. This included investigating the student experience, and examining the ways in which institutions encourage or discourage cross-disciplinary collaboration in teaching (see http://www-new1.heacademy.ac.uk/projects/detail/esd/esd_itlg and https://www.llas.ac.uk/projects/2892 [Accessed 21 June 2015). It is worth noting that none of the respondents to our study mentioned the work of this previous HEA group.

[11] The term '(post)graduate' designates both Masters and doctoral education.

provide incentives.
6. Value interdisciplinary mentoring or research in faculty tenure and promotion procedures.
7. Encourage funding agencies to support interdisciplinary research projects and training.

2. Methods

A study of the level of complexity and scope desired by HEA requires a mixed-method approach, and a combination of 'lenses' allowing larger and smaller pictures to be seen.

First, we sought to gain an overall sense of interdisciplinarity across UK HEIs by asking a few top-level questions of HEA's institutional contacts at subscribing institutions. The next step in our strategy was to drill 'where we expect oil': identifying key topic areas that were expected to be amenable to an interdisciplinary approach at both the undergraduate and postgraduate level.

The key dimensions of our research design encompassed the following methods:

1. To underpin the study, we conducted a literature review of pedagogy related to interdisciplinarity. Drawing on our experience in analysing previous work on interdisciplinary research and capacity building, our strategy with this review was to define parameters that embraced a comprehensive body of literature while maintaining a focus on educational provision and pedagogical methods. This review allowed us to identify pedagogies offering opportunities, key elements of practice including evidence regarding effectiveness, gaps in the evidence base and other overarching issues and principles. We sought to include 'grey literature', as well as peer-reviewed journals, project reports and books while being mindful of the quality of the research reported. We included evidence from overseas where appropriate.

2. For a comprehensive scan across HEIs, we surveyed HEA's network of Pro-Vice-Chancellors (PVCs) of Learning and Teaching (or their equivalents or delegates) in subscribing institutions. This online survey (see Annex G) was circulated by HEA on our behalf and sought recipients' views of their institution's interdisciplinary offerings at undergraduate or postgraduate level, the scale and type of current interdisciplinary provision, and future plans within institutional strategy or practice. Free text questions provided opportunities for further comment. Thirty-two responses were received. From those who provided their titles, it was clear that respondents were indeed at the senior leadership level sought, with a few leading a relevant office but most indeed at the level of Pro Vice-Chancellor. (In the analysis, all responding to this survey are referred to as 'PVC respondents'.) A range of institutions was represented, including several Russell Group institutions, at least one further education college, and several specialist institutions.

3. We used non-probability sampling to generate a representative sample of offerings in topical areas known to 'demand' interdisciplinarity in research and in policy/practice implementation. We identified five areas that are inherently interdisciplinary and have been identified by others[12] as challenges requiring an interdisciplinary approach:
    a. Sustainability
    b. International development
    c. Health (social dimensions)
    d. Games (digital)
    e. Culture

    We then conducted document analysis to search for related degree programmes across the UK at the undergraduate and postgraduate level using the UCAS database.[13] For each, about

[12] Such as RCUK's cross-council themes in six priority areas http://www.rcuk.ac.uk/research/xrcprogrammes/
[13] UCAS: Undergraduate Courses at University and College (see: www.ucas.com)

30 programmes were identified. Identification of programme directors by name, with email contact, took a great deal of sleuth work, as programme directors were not readily apparent in UCAS listings.[14]

4. Having identified this sample, and constructed our own sample database of 139 academic contacts, we sent an online survey (see Annex G) to directors of these interdisciplinary programmes. The survey consisted of a mix of Lickert scale, pre-coded, and free-text response questions and was designed to elicit informed reflection on issues, obstacles, opportunities and trends in interdisciplinary offerings, as well as lessons learned as to good practice and suggestions for tools that can be used and adapted for different settings and groups. Two reminders were sent, emphasising the potential of responses to contribute to a new level of understanding about interdisciplinary provision (while individual responses would remain confidential). Seventeen directors of interdisciplinary educational programmes returned their surveys, yielding a response rate of 12%[15]. At least one response was received from each theme or cluster; more responses (five from each) were received from health and from games than from other clusters.

5. To address this lower than expected response rate, we developed an alternative strategy which used a shorter survey instrument, containing a sub-set of questions from the full version (see Annex G), and circulated this to the following JISCMAIL groups:
    a. Staff and Educational Development Association (SEDA), approximately 1,150 members, a sub-set of whom may be interested in interdisciplinarity.
    b. Interdisciplinary Curriculum Group, approximately 15 members.
    c. National Combined Honours Network, approximately 50 members, course programme directors of combined or joint honours programmes.

    This elicited 23 responses. We were also able to take advantage of Lyall's attendance as the keynote speaker at the HEA's Enhancement Event in Belfast in March 2015 to administer the same survey with members of the audience during group discussion (n = 40).

6. To capture understanding of institutional cultures, drivers and obstacles for interdisciplinarity, as well as trends over time and suggested tools or practices, we conducted semi-structured interviews with five deans/PVCs of learning and teaching and 12 programme directors (or equivalent), from different types of institutions to seek evidence of effective approaches to the delivery and evaluation of interdisciplinary provision. All interviews were conducted by telephone and typically lasted 45-60 minutes. The interview topic guides are included in Annex A.

7. In order to help readers of this report to 'visualise' what interdisciplinary provision would look like in its various forms, we developed a set of six comparably structured case studies. These were selected purposively to illustrate a range of types of interdisciplinary offerings at different types of institutions, capturing different approaches that have been effective in

[14] Undergraduate programme leaders are rarely identified, instead prospective students are asked to email central admissions departments or departmental administrators. Programme leaders/course co-ordinators can occasionally be identified from staff lists but this is difficult when several departments are involved. Taught Masters programme details on the UKPASS website (https://www.ucas.com/ucas/postgraduate/postgraduate-study/what-ukpass) are much fuller and give contact details, though not usually names of programme directors. It is much easier to find the names of programme directors on institutional websites, though some larger institutions refer prospective students to postgraduate administrators. Not all postgraduate programmes are cited on UKPASS as institutions can recruit directly it is mainly a marketing tool, providing information mostly on taught postgraduate programmes.

[15] Discussions with some interviewees suggest that reasons for non-responses could include: general workload on academics making surveys unattractive; particularly heavy burden on programme directors such that the additional effort of responding to the survey was seen as too much; perhaps a fear that questions might entail looking up data, although invitation letters explicitly said this was not the case; or even that many programme directors may not have thought of their programme as interdisciplinary (perhaps with institutional representatives acting on their own initiative to 'market' the programme with that feature).

promoting, evaluating and sustaining interdisciplinarity. Case studies were based on information available on the web, augmented by survey data and one interview each.

8. The project Advisory Group (listed at the front of the report) provided an international dimension and acted as a 'critical friend'. Most of our interactions were online as we variously sought their advice on our work plan and sources of literature. We also held a meeting with members of the group on 12 June to invite their input on our findings and to comment on our draft report. Part of this meeting took the form of an informal focus group (see Annexes B and C for meeting agenda and topic guide). The study also benefited from informal discussions with the Interdisciplinary Curriculum Group following Lyall's invitation to speak to them about the project in London in June and from input from the HEA Steering Group, which met by phone in December, March and July 2015.

9. In summary, our purposive sampling strategy enabled us to collect data from informed individuals across the following categories:

Table 2.1: Categories of data collection

Category of respondent	**Method**	**Responses**
PVCs of learning and teaching	Online survey	32
Programme directors	Online survey	17
Targeted JISCMAIL groups	Online survey	23
Belfast conference attendees	Administered survey	40
Deans/PVCs of learning and teaching	Telephone interview	5
Programme directors	Telephone interview	12
Project advisory group	Focus group	4
Interdisciplinary Curriculum Group	Discussion	12
	TOTAL	145

2.1. Challenges and limitations

The potential scope of this study was challenging: no one study could uncover every unit of interdisciplinary provision in UK higher education. We recognise that research is almost always "a matter of informed compromise" (Bechhofer and Paterson 2000, p. 71) and sought to address this challenge with a research design based on a targeted sampling strategy, as described above.

A short, empirical study of this type[16] relies to a great extent on the goodwill of strangers being prepared to participate. In contrast to end-of-award evaluations of grant-funded research, for example, such participants may feel no obligation to contribute their knowledge. We have, in this study, experienced an unusually low response rate to one of our online surveys. Our Steering Group speculated that this might have been because we were contacting potential respondents at a time when a number of HEA studies were circulating surveys. Whatever the reason, as described in Section 2, we responded to this unexpected outcome by circulating alternative survey formats to a number of other groups known to have an interest in this topic.

[16] The project ran from December 2014 to June 2015.

3. Provision and pedagogies: opportunities for interdisciplinarity. Literature review

Summary

This chapter reports on a review of the literature about interdisciplinary provision and the pedagogies that might provide distinctive opportunities for interdisciplinarity.

We discern three common themes in existing research: descriptions of case studies presenting implementation of interdisciplinary teaching projects; analyses of the outcomes and challenges of interdisciplinary education; and discussions of the socio-cultural context of interdisciplinarity.

The scale of interdisciplinary provision indicated in the literature ranges from single workshops and courses[17] to certification programmes and Masters and PhD programmes.

Even though interdisciplinary courses, modules and programmes are conducted at every level of university education, their goals and planned outcomes are quite diverse. Interdisciplinary programmes and courses are most commonly (but not exclusively) available at the postgraduate taught (PGT) level or during the senior years of undergraduate education. However, the literature is not unequivocal with regards to the best locus of interdisciplinary education, especially regarding the timing of the first interdisciplinary course in a student's university experience.

Based on our analysis of the literature, we categorise teaching strategies that are variously termed 'interdisciplinary' into three groups: co-teaching, interactive methods and programme-level strategies.

3.1. Introduction

The literature on interdisciplinary teaching has been growing in recent years[18] but is scattered across both higher education and other discipline-specific journals. Moreover, articles dedicated solely to interdisciplinary provision in higher education, especially in the UK context, remain relatively sparse.[19] This observation, juxtaposed with the growing body of interdisciplinary courses and programmes being implemented in the UK (as indicated by survey analysis presented in the following section), might indicate that practical developments in the field are outpacing reflective analysis.

We discern three common themes in the existing research on this subject:

1. case studies presenting implementation of interdisciplinary teaching projects;
2. outcomes and challenges of interdisciplinary education;
3. socio-cultural context of interdisciplinarity.

The most extensive literature in the area of interdisciplinary teaching focuses on presenting case studies of interdisciplinary projects. Such case studies present entire programmes or particular courses and workshops. This strand of literature also focuses on particular teaching strategies and challenges in the cases examined. Examples include projects combining different disciplines, for example, Biology and Literature (Saunders and Ingalls 2013), Philosophy and Chemistry (Shibley 2006), Engineering and Social Science (Spitzer 2013); or present multiple disciplinary perspectives on a single issue, for example, climate change (Pharo *et al*. 2013) or sustainability (Liebert 2013; Willermet *et al*. 2013).

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[17] We have tried to use these terms unambiguously so that 'course' refers to a component module within a full degree programme but the literature, our informants, (and possibly the research team itself) is not always consistent in this usage.
[18] Search phrases connected to interdisciplinary teaching and learning yield up to 100,000 results in scholarly databases – see Annex D for a quantitative summary of search results.
[19] Even in the US with its much longer tradition of interdisciplinary teaching, the Association for Interdisciplinary Studies notes that relatively little of the research on, what they term, the scholarship of teaching and learning (SOTL) addresses interdisciplinary teaching and learning (see: www.oakland.edu/ais/scholarship [Accessed 5 June 2015].

Disciplines that seem to generate more extensive literature on interdisciplinary teaching include Medical Sciences, Law and Engineering.

The second theme in the literature covers issues connected to the diverse outcomes and challenges of interdisciplinary education (Elliott *et al*. 2001). The literature within this strand covers a broad spectrum of problems, for example, learning outcomes (Lattuca *et al*. 2004), institutional barriers (Nerantzi 2012) or challenges to teachers' co-operation (Perry and Stewart 2005; Pharo *et al*. 2012).

The third theme covers the broader context of interdisciplinarity. This includes institutional capabilities as well as the social and cultural constraints on interdisciplinary teaching and learning. Literature within this strand includes such themes as students' educational journeys (Haynes and Leonard 2010) or the socio-cultural context of institutions (Lattuca 2002).

As already noted, interdisciplinarity is a broad and complex phenomenon. As just one example, Heckhausen (1972, pp. 87–9) categorises pedagogical approaches to interdisciplinarity into six types:

1. Indiscriminate interdisciplinarity: used in pre-university settings; sees one discipline as dominating and others as auxiliary.
2. Pseudo-interdisciplinarity: when disciplines using the same tools claim to be interdisciplinary.
3. Auxiliary interdisciplinarity: when different disciplines use the same methodological approaches to yield data; might lead to conflict, if data produced using methods from different disciplines is not theoretically integrated into the main discipline.
4. Composite interdisciplinarity: when different disciplines are focusing on solving a single problem.
5. Supplementary interdisciplinarity: when disciplines belonging to the same field overlap in certain subject matters.
6. Unifying interdisciplinarity: when disciplines achieve consistency in subject matter, level of theoretical integration and methods.

We have chosen to build on rather than replicate Chettiparamb's (2007) earlier work by focusing this literature review on applied developments in interdisciplinary teaching practice that address three key themes:

- scale and locus of provision;
- drivers of interdisciplinarity;
- strategies for interdisciplinary teaching.

3.2. Scale and locus of provision

The scale and locus of interdisciplinary provision are impacted by multiple pedagogical, strategic and socio-cultural factors. There are several arguments supporting interdisciplinary education that are influencing the design of interdisciplinary courses which Woods (2006) categorises as:

1. Educational benefits – the ability to critically assess one's stand by viewing it from another discipline's point of view.
2. The reality of the modern workplace requiring multi-professional teamwork.
3. Global challenges (global warming, pandemics, international crime, migration, etc.) that require critical thinking and holistic approaches.

These challenges might be addressed on multiple levels of academic education. The scale of interdisciplinary provision indicated in the literature is quite extensive – ranging from single workshops and courses to certification programmes and Masters and PhD programmes. Writing from a US context, Klein (1990, p. 156) categorises interdisciplinary curricula into six groups:

1. Interdisciplinary universities;

2. Four-year undergraduate programmes;
3. Core-curricula and clustered courses;
4. Individual courses;
5. Independent studies;
6. Graduate and professional studies.

However, Blackmore and Kandiko (2012, p. 78) point out that the majority of UK institutions traditionally opt for mono-disciplinary undergraduate degrees (with a few notable exceptions).

Even though interdisciplinary courses, modules and programmes are conducted at every level of university education, their goals and planned outcomes are quite diverse, especially when comparing undergraduate and postgraduate education, which differ in strategies used, approaches and planned outcomes. Interdisciplinary programmes and courses are most commonly (but not exclusively) available at the postgraduate taught (PGT) level or during the senior years of undergraduate education (Holley 2009; Manathunga *et al*. 2006; Borrego and Newswander 2010; van Dam-Mieras *et al*. 2007). However, the literature is not unequivocal with regards to the best locus of interdisciplinary education, especially in terms of when is the best time for the first interdisciplinary course in a student's university experience.

For interdisciplinary education to be successful, many scholars claim that students need to be fluent in their initial discipline in order to successfully integrate elements of different perspectives (e.g. Davies and Devlin 2007; Derrick *et al*. 2012). Additionally, since interdisciplinary education is targeted at practical problems, interdisciplinary courses using real-life settings require use of existing knowledge and interaction with peers from different disciplinary backgrounds.

In contrast, some authors argue that early exposure to interdisciplinarity might be beneficial to students, since at the beginning stages of their education they have not yet developed the language their discipline speaks and are not fluent in the methods and paradigms of their disciple (Bentley 2007). Interdisciplinary courses, introduced before the disciplinary communication fully dominates students' lexicons, can be beneficial for students' future development (MacKinnon *et al*. 2013). MacKinnon *et al*. (2013) argue that introducing "bridging courses" early on in the undergraduate curriculum might help students better understand the context of their discipline.

Nevertheless, a majority of interdisciplinary courses are carried out at the postgraduate level. Derrick *et al*. (2012) in their practical guide suggest that graduate education, itself, is more interdisciplinary, since students are exposed to interdisciplinary research. At the same time, students in postgraduate programmes still need to develop in-depth expertise in their discipline. Therefore, according to these authors, graduate interdisciplinary education should be aimed at developing literacy across different disciplines (Derrick *et al*. 2012).

3.3. Drivers of interdisciplinarity

From the literature we can identify several drivers for starting interdisciplinary programmes and courses; we have classified these into the following five groups:[20]

1. Individual-level drivers;
2. University-level drivers;
3. External drivers;
4. Socio-cultural and economic drivers;
5. Evolution of the discipline.

[20] These are not mutually exclusive, since in many cases there may be more than one driver for establishing or continuing interdisciplinary programmes and courses.

Individual-level drivers of interdisciplinarity include cases where projects result from individual inclination, such as personal friendships and co-operation between academics (e.g. Shibley 2006).

University-level drivers include projects initiated by the higher education institution's regulations or degree requirements, for example, the requirement that students take an upper-level writing class with global perspective (Goodman and Huckfeldt 2013), or initiated by the university's strategic focus on interdisciplinarity (e.g. Buchbiner 2005).

This category of drivers includes **external motivators**, outside the university. Examples of drivers of this kind include external sources of funding, such as the Integrative Graduate Education and Research Traineeship (IGERT) programme in the US[21] (e.g. Borrego *et al*. 2014; Borrego and Newswander 2010; Manathunga *et al*. 2006). Other international external drivers of interdisciplinarity include UNESCO's Education for Sustainable Development initiative, which was a force behind establishing the Interdisciplinary, Intercultural Masters Programme on Sustainability (van Dam-Mieras *et al*. 2007).

The fourth category includes drivers related to the **socio-cultural and economic challenges** of the modern economy. Drivers of interdisciplinarity within this category include trends in education and industrial workplaces, including the changing role of the university and the need to prepare graduates for this changing and complex work environment (Elliott *et al*. 2001; Manathunga *et al*. 2006).

The last category includes **development of the discipline** as a driver of interdisciplinary teaching (Dymond *et al*. 2009; Holley 2009; Yang 2009) where new disciplines (such as neuroscience, environmental studies and synthetic biology) have evolved from precursor disciplines, primarily as a result of interdisciplinary research collaborations.

3.4. Strategies for interdisciplinary teaching

Creating an interdisciplinary curriculum is a challenging task; OECD (1972) has delineated three categories of challenges:

1. rigidity of institutional structures;
2. rigidity of people involved, including resistance offered by disciplinary frameworks;
3. lack of facilities.

Similarly, Chettiparamb (2007) categorises problems with interdisciplinary teaching into two groups: institutional problems and people problems. The organisational culture of the university supports disciplinary ways of thinking and behaving, with faculty implementing the interdisciplinary programmes (usually) trained in specific disciplines (Woods 2006). An important human factor that might impact the long-term success of the interdisciplinary course is the ability to successfully introduce new co-teachers, in order to maintain the continuity of the course after the initial set of academics establishing the interdisciplinary courses has moved on to other positions (e.g. Drake *et al*. 2008).

Important aspects of research practice are based on tacit knowledge, and therefore interdisciplinary education is a challenging task for both students and teachers (Toynton 2005). Furthermore, disciplines differ in the level of formalisation of the field but this may be less apparent to academics trained in other disciplines. Additionally, some limitations are inherent to the discipline (Chettiparamb 2007). Therefore, while implementing interdisciplinary programmes, universities cannot ignore existing structures and cultures (Borrego *et al*. 2014).

[21] The National Science Foundation's IGERT programme, established in 1998, has awarded approximately 100 grants worth 2-3 million dollars each to catalyse a cultural change in graduate education and promote interdisciplinarity.

Empirical case studies confirm these challenges. Van Dam-Mieras *et al*. (2007) identify institutional inflexibility and differences in understanding of concepts and goals as key obstacles in implementing an international Masters degree in sustainability. Multiple studies have shown the crucial role of institutional support in the success of interdisciplinary programmes and courses (e.g. Burgett *et al*. 2011; Drake *et al*. 2008; Orillion 2009). Correspondingly, Holley (2009) has named the disciplinary structure of the university as one of the most important factors impacting the implementation of an interdisciplinary curriculum in neuroscience. One of the challenges in creating an interdisciplinary curriculum is setting goals that would be understood and agreed upon by academics from different disciplines, and by students who are more accustomed to disciplinary settings within the university. In the case of the graduate programme in neuroscience, students have pointed out a lack of understanding of the goals of the programme and advisors from different disciplines, and a lack of institutional support to mitigate these challenges (Holley 2009).

Therefore, a successful interdisciplinary curriculum should be aimed at mitigating the institutional and personal challenges of interdisciplinarity on the one hand, and fulfilling specific learning objectives expected from interdisciplinary education on the other. At the same time, there are no unified guidelines for creating the interdisciplinary curriculum. In their systematic review of the interdisciplinary projects within nursing programmes at UK universities, Cooper *et al*. (2001) have pointed out that most projects do not have any theoretical underpinning behind the decisions to use specific methods in teaching courses.

Interdisciplinary courses pose a challenging task for both the teacher and the students. The students might have to take a second subject that they are not fully prepared to study, might not speak the language of the discipline or might not have the aptitude to study it (Davies and Devlin 2007). Additionally, in order to achieve fluency in interdisciplinary inquiry, students have to develop both qualitative and quantitative forms of reasoning (Hothem 2013).

Also, as argued by Orillion (2009), there is a difference in understanding of what defines disciplines and interdisciplinarity. Disciplines are largely understood in terms of theories and methodologies, while interdisciplinarity is defined by a process of synthesis (Klein 2010b). Szostak (2007) claims that, because the essence of interdisciplinary learning is teaching students how to integrate different theories and methods, therefore the process of learning should be different from a strictly disciplinary one, where students learn fewer different theories and methods, but go more in depth in understanding of them. Just learning broadly about multiple different topics will not be beneficial to the student, unless they learn how to integrate knowledge (Szostak 2007). In response to critics who claim that interdisciplinary studies are not rigorous, Szostak contends that:

> The rigor in interdisciplinarity can only come from knowing how, why, and what to integrate *(Szostak 2007, p. 4).*

Spelt (2014, 2009) discusses a set of "enabling conditions" that have an impact on achieving the objective of developing the ability of interdisciplinary thinking among students. These include (Spelt *et al*. 2014, p. 4):

- personal characteristics;
- prior experiences;
- teacher;
- pedagogy;
- learning process pattern;
- learning activities;
- assessment.

These characteristics of interdisciplinary teaching, and the set of specific challenges they pose, may lead to the development of specific groups of techniques, helping academics to design effective interdisciplinary courses. The design of an interdisciplinary course will have an impact on the extent of

the dialogue between disciplines. Bentley (2007), in her case studies of interdisciplinary education in teaching literature, has pointed out that the relationship between disciplines might be passive or active. In passive interdisciplinary teaching, one discipline is used to simply illustrate the other (for example, Art and Literature) or is presented as the other point of view, but still with one teacher present in the classroom. Such approaches can lead to exploitation or silencing of one discipline by the other (Bentley 2007, p. 12). The more active approach to the exchange between disciplines occurs when both disciplines are represented in the classroom, for example by co-teaching. This allows for both disciplines to have more equal power and persuasion.

Nikitina (2006) categorises interdisciplinary teaching strategies in three groups, based on the type of inquiry: contextualising, conceptualising, and problem solving. Contextualising is a strategy used in Humanities, and it includes analysing facts and theories in the cultural, ideological and historical context. Conceptualising is most common in disciplines based on the integrative type of inquiry. Problem solving is most common in disciplines that are focused on practical applications of the scientific inquiry.

Similarly, Blackmore and Kandiko (2012, p. 78) argue that approaches to interdisciplinarity vary across disciplines. They call the Humanities and Social Science models 'self-contained', as different disciplinary perspectives are integrated within one honours degree. On the other hand, sciences and some of the social sciences are operating within an 'externalised model', where disciplinary knowledge is explored to create new knowledge.

Based on our analysis of the literature, we categorise teaching strategies that are variously termed 'interdisciplinary' into three groups (Table 3.1), which we now discuss in turn.

Table 3.1: Synthesis of interdisciplinary teaching strategies and pedagogical techniques

Strategy	Pedagogical techniques
Co-teaching	> Advanced planning and negotiation with co-teacher > Co-advising with industry representatives > Taking turns in teaching > Creating learning community > Co-creation of syllabus and case studies
Interactive methods	> Project-based learning (PBL) > Case study methods > Role-playing > Simulations > Virtual methods > Peer-assessment and review > Peer-assisted Learning (PAL) > Small-group teaching
Programme-level strategies	> Interdisciplinary electives > Core courses covering material from different perspectives > Research conducted for the initial stages of graduate school

3.4.1. Co-teaching

The first group of strategies used in interdisciplinary education can be categorised as co-teaching or team teaching techniques. There are three types of team teaching as indicated by Perry and Stewart (2005, p. 564) based on Sandholtz (2000):

1. two or more teachers loosely sharing responsibilities;
2. team planning, but individual instruction;
3. joint planning, instruction, and evaluation of learning experience.

Courses taught by teachers from different disciplines pose a specific set of challenges. Shearer categorizes the problems with designing an interdisciplinary module into three categories (Shearer 2007, p. 7):

1. content – how to combine the depth of the discipline with time constraints;
2. assessment – how to combine the different ways disciplines evaluate knowledge;
3. practical arrangements – how to organise work and interaction between people from different departments.

There are pedagogical differences between disciplines, including different understanding of teaching methods, learning outcomes and assessment objectives and criteria. Knights and Willmott (1997) identify two approaches to interdisciplinary teaching. The first one is 'mechanistic pooling', where two or more teachers with different disciplinary backgrounds present one issue from different perspectives to create a fuller picture of the issue at hand. The second approach is 'systematic colonization', where teachers with grounding in one discipline gradually expand their expertise to issues traditionally assigned to other disciplines. Differences in pedagogical styles and approaches to interdisciplinarity between teachers should not be ignored, since they might sometimes lead to the failure of the interdisciplinary courses (see e.g. Shibley 2006).

As indicated by Perry and Stewart (2005), effective partnerships in interdisciplinary teaching are based on three components: experience; personality and working style; and beliefs about learning. These authors argue that the 'experience' element of partnership is usually the easiest one to fix, since it generally improves with time. Differences in personality and teaching style might be more problematic; however, partners can make adjustments to improve their working relationship. Perry and Stewart (2005) argue that the most complex and important component of successful teacher co-operation in interdisciplinary projects is shared belief about learning. This includes shared pedagogical philosophy and perception of roles and expectations (Perry and Stewart 2005, p. 527).

One of the main strategies indicated in the literature to mitigate potential conflicts and to increase chances of successful implementation of interdisciplinary teaching projects is spending a sufficient amount of time on planning the course to cover as much detail as possible (Shibley 2006). Some issues that should be covered in the planning stage of the interdisciplinary course include: negotiating teaching approaches, assessment criteria and responsibility for grading (van Dam-Mieras *et al.* 2007), and relationships between different disciplinary approaches on the way to achieving the learning objective of the course (Saunders and Ingalls 2013).

3.4.2. Interactive teaching strategies

The second group of interdisciplinary teaching strategies is focused on innovative, interactive methods of teaching in order to achieve learning outcomes that are quite difficult to develop and evaluate. Shearer underlines two main themes in the literature on interdisciplinarity (Shearer 2007, pp. 5–6):

1. connections – synthesizing and integrating perspectives from different disciplines;
2. perspective taking – developing the ability to look at the problem from the other discipline's perspective.

Pedagogical strategies associated with interdisciplinary education are based on active learning, in order to promote higher-order critical-thinking skills (Chettiparamb 2007), since interdisciplinary courses are usually targeted at such results as improved critical thinking, meta-cognitive reflection, problem-solving and analysis, self-direction or synthetic thinking skills (Haynes and Leonard 2010). These expectations have been partially confirmed in experimental studies on interdisciplinary learning. In the experiment conducted by Elliott *et al.* (2001), two groups of students took either an interdisciplinary or a traditional algebra class. The results of the study show that interdisciplinary teaching had no effect on problem-solving skills, compared to traditional teaching techniques, but students who took the interdisciplinary class showed higher scores in critical-thinking skills and attitudes toward learning. Remington-Doucette *et al.*'s (2013) study has shown that participating in an interdisciplinary course in sustainability had different impacts on the skills of students from different

disciplinary backgrounds. Business majors did not improve in any of the measured competencies, sustainability majors improved in systems thinking competence, and sustainability minors showed improvement across all competencies (Remington-Doucette *et al*. 2013).

Yang (2009) proposes that interdisciplinary education should be outcome-based. Educators planning interdisciplinary education ought to define the learning outcomes first and then choose teaching and assessment methods targeted at providing such outcomes. Van der Waldt (2014, p. 182) names the following skills as possible outcomes in interdisciplinary outcome-based curriculum design:

- collecting, analysing, organising and critically evaluating information;
- using science and technology effectively and critically, showing responsibility towards the environment and the health of others;
- demonstrating an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation;
- participating as responsible citizens in the life of local, national and global communities;
- being culturally and aesthetically sensitive across a wide range of social contexts.

Spelt (2014, 2009) has indicated that in order for interdisciplinary education to achieve planned outcomes, it is necessary for students to master five sub-skills:

- having knowledge of disciplines;
- having knowledge of disciplinary paradigms;
- having knowledge of interdisciplinarity;
- higher-order cognitive skills;
- communication skills.

These skills are considered to be 'sub-skills', since they represent an intermediate stage in outcome-based learning, necessary for the course convenors to identify teaching, learning and assessing strategies to achieve outcomes (Spelt *et al*. 2014, p. 4).

The methods aimed at developing higher-order critical thinking skills can be categorised in two groups – imitating real-life settings and aimed at group learning.[22] The first group of teaching strategies takes advantage of real-world complexities and are highly dependent on students' individual efforts. Methods that have been used in interdisciplinary teaching projects include project-based learning, case study methods (Buchbinder *et al*. 2005; Goodman and Huckfeldt 2013; Yang 2009), simulation and role-playing (Balsiger 2015). The second category of methods takes advantage of the group setting of teaching interdisciplinary courses, usually consisting of students trained in different disciplines. Projects realised in this stream of research have included such techniques as: peer-review, peer-assessment, conferences, group projects (Manathunga *et al*. 2006), peer-assessed learning (Saunders *et al*. 2012) and small group teaching (Cooper *et al*. 2001). Interdisciplinary education is also a field of exploration of new educational technologies, such as virtual learning (van Dam-Mieras *et al*. 2007). In interdisciplinary courses, interactive techniques might be adapted by a more 'passive' discipline. For example, Zartner (2009) names the following methods from Law education used in Political Science: IRAC (Issue, Rule, Analysis, and Conclusion), court cases, fact patterns (simulations), and moot court.

3.4.3. Programme-level strategies

The third category of strategies in interdisciplinary teaching involves the design of the entire interdisciplinary programme. Blackmore and Kandiko (2012, p. 79) point out that the most common approach to including interdisciplinarity in the undergraduate curriculum is to condense the traditional, disciplinary courses and offer additional, interdisciplinary courses. As a result, interdisciplinary courses may be seen as taking away from the rigorous core curriculum.

[22] These two groups might overlap.

At the programme level, interdisciplinary education strategies involve core courses covering knowledge from different disciplinary approaches, interdisciplinary electives and practical implementation of knowledge from the early stages of graduate education, for example, laboratory research and joining research teams (Holley 2009).

Teaching strategies addressed in the literature are consistent with the guidelines found in the QAA/HEA (2014) report on using an interdisciplinary approach in teaching sustainability. The methods delineated in that report include:

- case studies;
- stimulus activities;
- simulation;
- experiential project work;
- problem-based learning.

The authors of the report underline the importance of the real-life setting of interdisciplinary education in the area of sustainability, for example by including real-life examples in case studies, simulations and PBL, story-telling in stimulus activities, and community involvement in experimental project work.

These programme-level strategies are clearly present in the Melbourne Model and the University of Aberdeen's Sixth-Century Courses, mentioned in the introduction to this report, and in the University College London's Arts and Sciences BASc described in Section 5. We will, however, return to the question of whether such curriculum enhancement initiatives might truly be termed 'interdisciplinary' or whether the broader description of 'integrative learning' is more apt, in Section 6.

4. Scale of interdisciplinary provision: results from surveys and interviews

Summary

This chapter reports on empirical data from surveys and interviews to indicate the scale of current and anticipated future interdisciplinary provision.

Institutional context and current provision

Interdisciplinary learning and teaching is an explicit component of many institutional strategies. It is a 'live' topic at the leadership level within HEIs where nearly three-quarters of PVC respondents report engaging in these discussions and one third report an increase in proposals for interdisciplinary programmes (not simply modules). This overall awareness of institutional context and provision is somewhat less evident at the level of the individual academic.

When asked about current interdisciplinary provision, nearly half of PVC respondents estimate that their institutions have more than five interdisciplinary undergraduate programmes and a quarter claimed more than ten. Shifting the focus to PGT, almost half of the same group again estimate more than five programmes. However, this time only 15% estimated more than ten and a quarter of these PVC respondents replied that there are *no* explicitly interdisciplinary taught postgraduate degree programmes at their institution currently.

Drivers

There were marked differences in perspectives regarding the drivers for interdisciplinary provision with university leaders highlighting professional/vocational needs and graduate employability while academics at the level of programme director predominantly identify championing by individual academics and the need to align teaching with complex societal issues as the main drivers. About half of each group identifies alignment with research directions.

Scope of interdisciplinary provision

The 'scope' of current interdisciplinary provision in terms of academic areas bridged suggests that this is predominantly an activity encompassing Arts, Humanities and Social Sciences although other combinations do certainly occur (e.g. Natural Science/Social Science bridging was seen by well over a third of our respondents).

Pedagogy

Interdisciplinary education was seen to manifest itself in a range of pedagogical activities although what is termed 'interdisciplinary' education is not necessarily integrated throughout every aspect of a programme and we find mixed views among our respondents as to whether provision labelled 'interdisciplinary' is, in actuality, an aggregate of different pre-existing modules from different courses, with only one or two new modules designed to be integrative. Interdisciplinary competences gained by students were variously identified as an ability to synthesise, appreciation of diverse perspectives, and flexible, critical thinking.

Challenges

The degree of challenge in effecting this type of culture change is indicated by the fact that nearly three-quarters of programme director respondents agreed that most academic staff simply wish to teach their usual modules in familiar subjects and not become involved in synthesis. Opinion was almost equally divided on the extent to which it was primarily the student's responsibility to integrate the various contributions of different teachers/modules in an 'interdisciplinary' programme. Assessment was clearly a particular challenge for interdisciplinary programmes as were various administrative problems such as the logistics of timetabling and resource allocation, not least the equitable distribution of teaching 'credit'.

Opportunities and advantages

Opinion was equally divided among programme director respondents as to whether their institution was likely to reward their leadership of an interdisciplinary educational programme. Yet, nearly all agree that they and colleagues feel a "sense of excitement" when teaching an interdisciplinary programme; new thinking has been stimulated and research activity has been influenced. As well as the intellectual benefits for students, respondents commented on increased employability.

Likely institutional trends

Across all respondents, most feel that the level of interdisciplinary educational provision has increased at their institution over the past five years although a significant proportion believe that the level is unchanged. Programme directors are more likely to report this increase than academic leaders.

Looking to the future of interdisciplinary educational provision at their institution over the next five years, most respondents expect the level to increase. Programme directors envisioned a much higher proportion of interdisciplinary education in five years' time at both undergraduate and postgraduate levels than did academic leaders. Perhaps the most striking differences between PVC and programme director respondents lie in the latter's generally greater expectations for postgraduate interdisciplinary education (taught or research), and far lower expectation for interdisciplinarity in professional/vocational courses.

Professional capacity-building

Finally, we explored the extent to which academics, academic development staff, and academic leaders are prepared for such changes. There was near unanimity among all respondents that access to a body of good practice in interdisciplinary provision would be beneficial but this contrasts sharply with current reality where, for example, only a quarter of programme director respondents and a third of PVC respondents said that their institution's staff development support explicitly included interdisciplinary teaching. Suggestions for appropriate support that would help staff to be more

effective in interdisciplinary teaching included access to research and good practice (e.g. in the form of case studies), skills development (e.g. through organisation of masterclasses or tutor training), funding for trials and test projects, and more formalised institutionalised support (for example, the inclusion of interdisciplinarity in PGCHE provision).

4.1. Institutional context and current provision

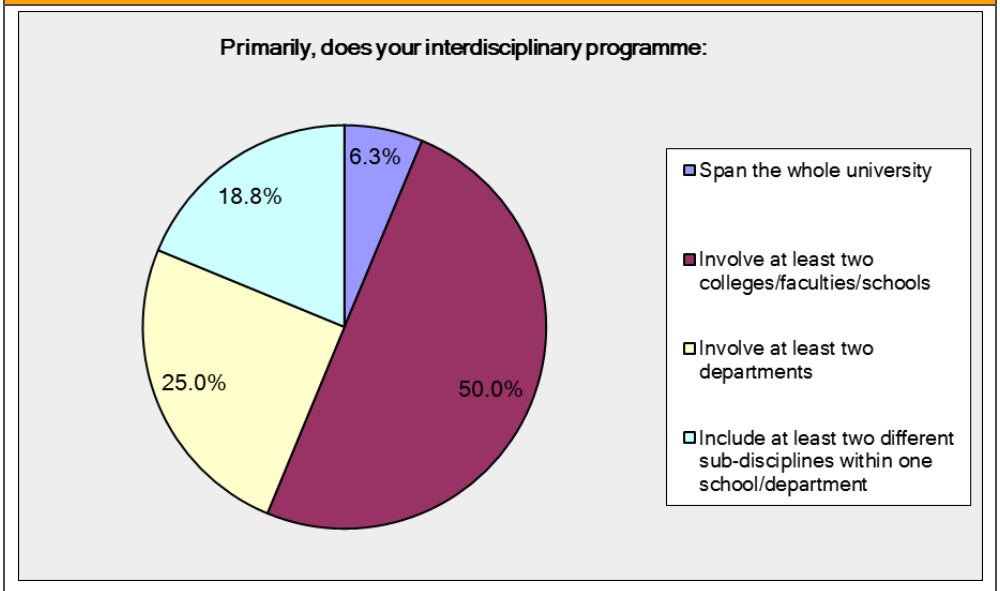
Despite the limited numbers noted in the previous chapter, thoughtful programme director respondents provided interesting insights drawing upon a range of types of hands-on experience. When we asked them about the nature of their programmes:[23]

- 82%[24] said it was aimed at taught postgraduates (PGT);
- 41% at undergraduates (UG);
- 24% at research postgraduates (PGR).

In terms of institutional span (Chart 4.1):[25]

- only one of these programmes spanned the entire university;
- half primarily involved two colleges/faculties/schools;
- a quarter involved at least two departments;
- just under one-fifth included at least two different sub-disciplines within one school/department.

Chart 4.1: Interdisciplinary 'span' as seen by programme directors



Interdisciplinary teaching/educational provision does appear in many institutional strategies. When PVC respondents were asked about their institutional strategies, two-thirds said that interdisciplinary teaching/educational provision is an explicit component while just slightly more (72%) said that interdisciplinary *research* is an explicit component of their institutional strategies.[26] Similarly, just under two-thirds of programme director respondents agreed although – unlike the PVC respondents – nearly a quarter were not sure. Again, a similar picture was given by programme director respondents

[23] Respondents could select more than one option

[24] Throughout this analysis, when referring to any of the surveys, percentages are given in relation to number of responses to a particular question

[25] Selected charts are included in this Section; the full set is included in Annex E.

[26] Of course the sample choosing to respond to a survey on interdisciplinarity is self-selecting and may well be particularly likely to come from institutions where interdisciplinarity is an emphasis.

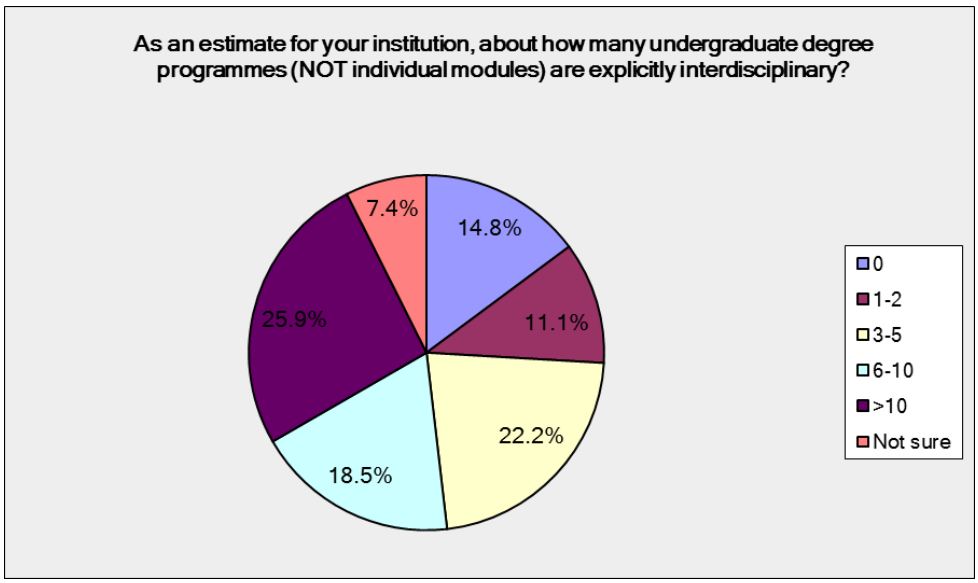
as to interdisciplinary research being an explicit component of institutional strategy, with a slightly higher level of agreement at over two-thirds although still nearly a quarter not sure.

The emphasis on interdisciplinarity would seem to go beyond 'paper' as nearly three-quarters of the PVC respondents and over half of the programme director respondents agree that there is frequent discussion about the challenges and opportunities of interdisciplinary teaching; it is a 'live' topic at their institutions. It would seem that PVC respondents' overview may often give them sight of more discussions than those seen by an individual academic.

Again drawing upon their 'overview perspectives', PVC respondents were asked about interdisciplinary educational activity at their institutions. A third of PVC respondents are seeing an increase in proposals for interdisciplinary programmes (not simply modules); more than a quarter disagree, with the rest neutral.

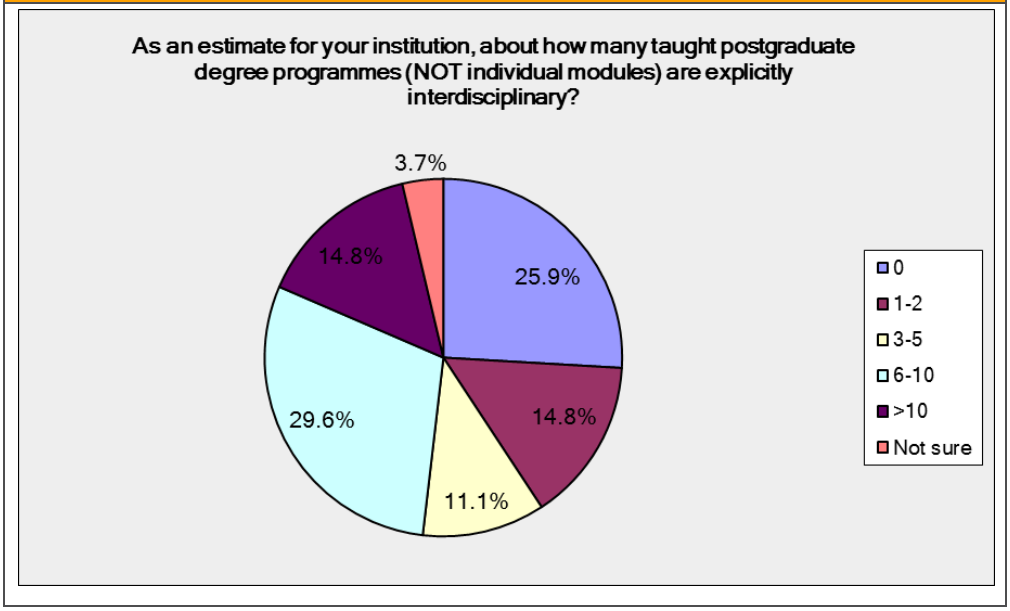
When asked for an estimate of how many of their institution's current undergraduate degree programmes (not individual modules) are explicitly interdisciplinary, nearly half of PVC respondents estimate that their institutions have more than five interdisciplinary undergraduate programmes (Chart 4.2).

Chart 4.2: Number of interdisciplinary undergraduate programmes, estimated by PVCs



When asked to estimate the number of taught postgraduate programmes at their institution (Chart 4.3), 44% of PVC respondents also estimated more than five programmes. However, only 15% estimated more than ten. Interestingly, a full quarter of PVC respondents replied that there are *no* explicitly interdisciplinary taught postgraduate degree programmes at their institution, distinctly more than the 15% who saw no such undergraduate programmes.

Chart 4.3: Number of interdisciplinary taught postgraduate programmes, estimated by PVCs



Some PVC interviewees observed differences between interdisciplinary provision at undergraduate and taught postgraduate levels. So, for example, one commented that although, when innovative interdisciplinary modules were launched at their institution, the market originally envisioned was undergraduate, at least a third of the students are taught postgraduates. Some would suggest that postgraduates might tend to be particularly motivated to make the most of elements of their degree programme, such as interdisciplinary project experiences. Commitment to interdisciplinarity is not necessarily the key driver:

> The taught postgraduate market is very interested in this sort of additional accomplishment – not interdisciplinarity so much as taking advantage of additional certificated opportunities. *(PVC interviewee).*

Another PVC interviewee differentiated between interdisciplinarity at the two levels on the basis of 'protecting' undergraduates from getting a degree in a new area that might not stand the test of time:

> [At our university] we focus on design of interdisciplinarity at the Masters level; we are not sure of the long-lasting nature of interdisciplinarity at the undergraduate level … we encourage interdisciplinarity that is novel (even if) potentially short-lived at the Masters level. The ones I feel comfortable about are the ones that help someone with a crossover point to a new profession, a career switch … then your value is defined by your profession and the name of the Masters won't matter. *(PVC interviewee).*

Masters programmes, if specifically designed to be interdisciplinary, have the opportunity to be more than a simple aggregate of modules or lectures from different fields; they can have an 'emergent outcome' from synthesis. One example provided was an MSc in International Animal Welfare, bringing in ethics and Law to what might otherwise be a Veterinary Science topic; another was a combination of Business and Environmental Studies in what was then a new area, carbon management.

Individual undergraduate modules or sub-units do not bear the same 'responsibility' as a named degree programme; indeed experiences and skills gained within them can contribute to employability (for instance helping graduates to be comfortable working with people from other disciplines, in teams) and to intellectual benefits ('interdisciplinarity can liven things up, open students' eyes'). Multiple disciplines can allow students to take such modules, which thus provide a service broadly within an institution. Modules may take the form of experiential learning, such as problem solving in the community, or they may have an intellectual focus that is an emergent outcome of several fields coming together.

As illustrated by our case studies (Section 5), interdisciplinary undergraduate education can take on many forms, ranging from one or a few interdisciplinary modules to a comprehensively designed degree programme. A few, such as the University of Manchester's University College for Interdisciplinary Learning, are even identified as 'colleges' within an institution. Programme directors talk in different ways about the purpose or ethos of their programmes. One, for instance, used the metaphor of a 'passport' across existing structures, noting that:

> We place a lot of emphasis on a degree giving a student a passport to current offerings in [different] departments. They can opt for majors that mostly map onto existing departments [or] within hard constraints of necessary prerequisites, students can take pretty much whatever is on offer, rather than creating a new curriculum. *(ProgDir interviewee).*

As an example of a different format, one with an interdisciplinary 'spine', another programme, described as somewhere between a UK model and the US liberal arts model that inspired the university's senior leader on a visit to US institutions, offers four core units (two in each of the first two years) for all its liberal arts students, with the core units themselves interdisciplinary, asking 'the big questions', and taught by people from various departments. Each student also chooses a major, or 'pathway', after having the opportunity to explore two possible pathways in the first year. Promoted as having "coherence, focus and rationale", and providing a unique set of skills and knowledge, this programme still offers students a great deal of flexibility. (This programme can be taken as a three-year degree or a four-year integrated Masters, with the third year abroad.)

Somewhat similarly, a European liberal education programme, based on the American model, includes an interdisciplinary core with four obligatory courses that teach students to do and reflect upon interdisciplinary work (along with some distribution requirements to think about different ways of knowing). Time and staff-intensive, core courses in small groups include a writing course within which essays are to develop connected thinking, a course on how different perspectives look at a complicated topic like globalisation, and genuinely interdisciplinary research projects. Students interview researchers in their home departments about epistemologies, ethics and so on; students become much more aware of their own specialisation from a meta-perspective. Reflection is a key component of the approach, for instance students develop portfolios of writing:

> We want them to reflect on what they are doing; the main goal is interdisciplinary awareness, doing and thinking about why they are doing this. *(ProgDir interviewee).*

Another programme director explicitly includes reflection in a third year dissertation module, which involves an extended thought piece reflecting on the students' major and hinterland of other subjects they looked at, looking at approaches more than topics; but individual reflection alone is not the culmination:

> The final step is bringing people back together in smaller group projects across different majors – the endpoint is you do talk to people doing different things and you need to put the project together. Students do appreciate that this resembles real life, that most jobs involve working collaboratively and being aware of others' interests*. (ProgDir interviewee).*

There is a sense that some students are more prone than others to taking up interdisciplinary or otherwise innovative offerings (as indeed is the case for some academics in providing them):

> I think I am recognising and rewarding the kind of students who would have done these kinds of things anyway. *(ProgDir interviewee).*

Another suggestion is that disciplinary background of postgraduate students matters: depending on their undergraduate degree, some "find it easier to hit the ground running." Another observation from one of our interviewees is that individuals may be more receptive to interdisciplinarity at different stages in their lives.

Interdisciplinarity may well be mentioned but not necessarily emphasised or empowered in institutional strategies, as many programme directors would observe. Yet, some universities seek

educational innovation, which may include but not be limited to interdisciplinarity. PVC interviewees, for example, may see interrelationships between interdisciplinarity, project-based learning and/or problem-solving outwith academia. At one university, selected PhD students come up with an interdisciplinary module, so that, as well as their students, they are themselves gaining unusual experience. In this context, collaboration and team working are often cited as important career skills, including appreciation of others' skills and ability to communicate and operate within group dynamics, or indeed to 'cope with uncertainty'. It may be that institutions devoted to the Arts are especially open to interdisciplinarity in some forms, as many endeavours in the Arts require people from different backgrounds working together, and indeed some may see natural connections between creativity and a sensibility, an appreciation that "not everyone thinks in the same way."

4.2. Drivers

Different perspectives were sought as to the drivers that have led to interdisciplinary provision at either or both undergraduate and postgraduate.[27] There were striking differences in the weighting placed on these drivers among the four groups of respondents across our combined dataset (Chart 4.4).

Among those PVC respondents who claimed more than zero interdisciplinary programmes at their institutions, two drivers stood out as selected by about two-thirds of the PVC respondents:

- professional/vocational needs;
- employability.

Yet, a third or less of programme director respondents selected these as drivers leading to their programme.

The two drivers most often selected by programme director respondents were each chosen by nearly three-quarters:

- alignment with complex societal issues;
- championing by individual academics.

Interestingly, just half of PVC respondents selected these drivers.

The Belfast conference respondents appeared to have a perspective quite similar to that of PVC respondents. Their most frequently selected driver was:

- employability.

This was followed by:

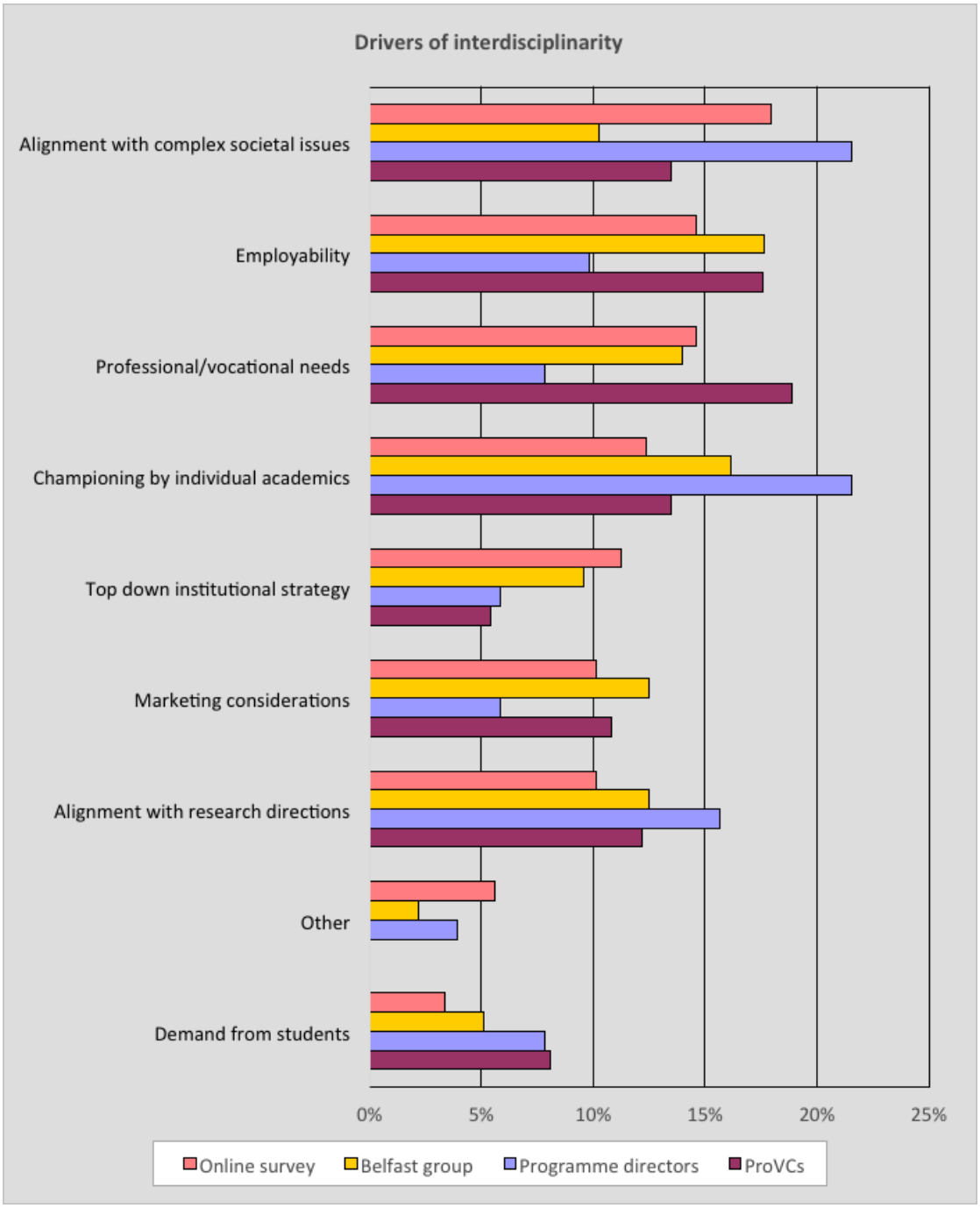
- championing by individual academics;
- professional/vocational needs.

In interview, PVCs are aware of the difference between drivers for interdisciplinary *research* and for interdisciplinary *education*:

> Academics are naturally quite conservative; they tend to stick tightly to what they know and are not as bold in general as you think they might be in going beyond their area of comfort, in both teaching and research. In research, there are funders saying interdisciplinarity must happen; that is not true in teaching, so it is not happening. *(PVC interviewee).*

[27] Respondents were presented with a list and could select as many as they thought applicable.

Chart 4.4: Drivers of interdisciplinarity (full dataset *n* = 112)



4.3. Scope of interdisciplinary provision

The 'scope' of interdisciplinary provision was explored in terms of the academic areas bridged. When PVC respondents who had claimed one or more interdisciplinary programmes were provided with an array of interdisciplinary combinations, and asked to tick all that apply at their institution, just two were selected by more than half:

- Humanities/Social Science;
- Arts/Humanities.

The next most often selected were:

- Arts/Social Science (50%);

- Social Science/Social Science (45%);
- Natural Science/Social Science (40%).

No other combination was selected by more than a quarter of the PVC respondents. Although of course dependent upon the nature of the institutions of those who replied, this picture of relative types of interdisciplinary bridging is a thought-provoking snapshot.

By virtue of their roles, programme director respondents were focused on a particular 'bridging' situation within their own programme. Only one type of interdisciplinary combination was selected by more than half (64%) of the programme director respondents:

- Humanities/Social Science.

The only other two frequently selected combinations (each at 43%) were:

- Natural Science/Social Science;
- Natural Science/Humanities.

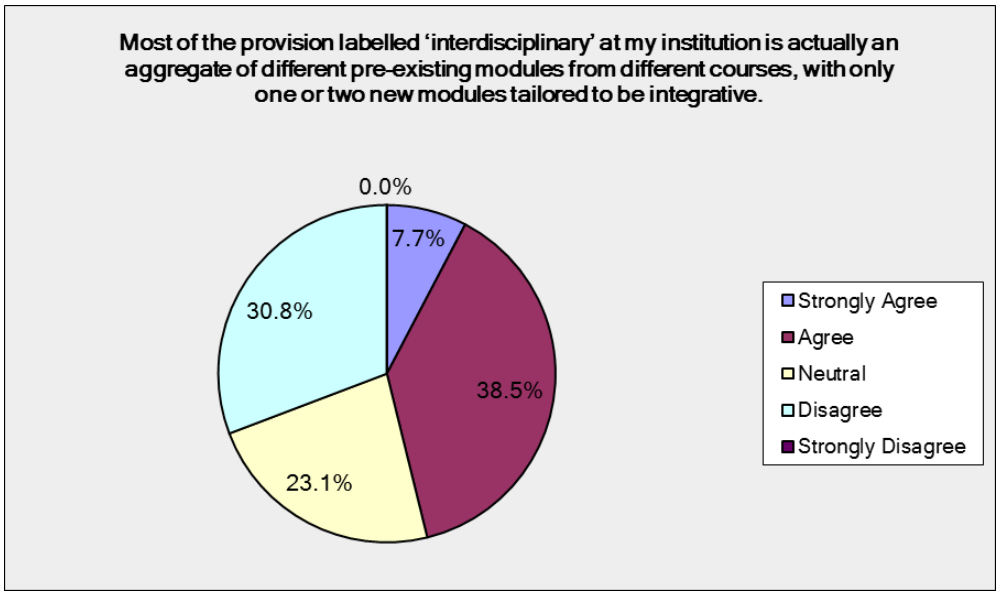
No other combination was selected by over 30% of programme director respondents, although two were selected by more than a quarter (29%):

- Arts/Humanities;
- Arts/Social Science.

4.4. Pedagogy

What is called interdisciplinary education is not necessarily integrated in an innovative way throughout every aspect of a programme. Indeed, nearly half of the PVC respondents agreed that "the provision labelled 'interdisciplinary' at my institution is actually an aggregate of different pre-existing modules from different courses, with only one or two new modules tailored to be integrative." Less than a third disagreed (Chart 4.5).

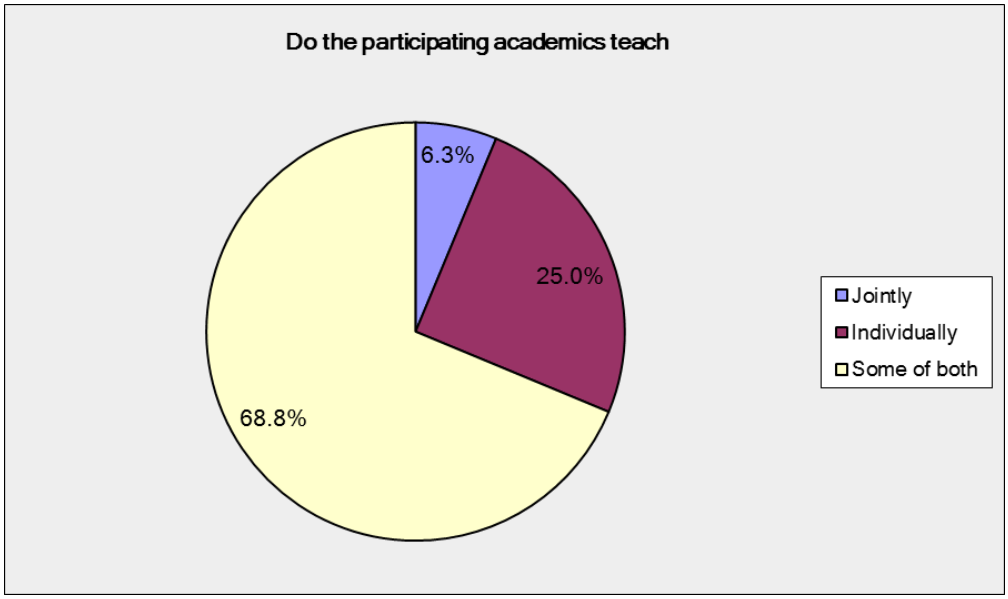
Chart 4.5: Integration through only one or two new modules, as seen by programme directors



Programme director respondents were split evenly between two quite different approaches to interdisciplinary provision, with 47% agreeing and 47% disagreeing with the statement that, in their own case "primarily, my interdisciplinary programme is integrated by one or two new modules tailored to be interdisciplinary across an aggregate of different pre-existing modules from different courses."

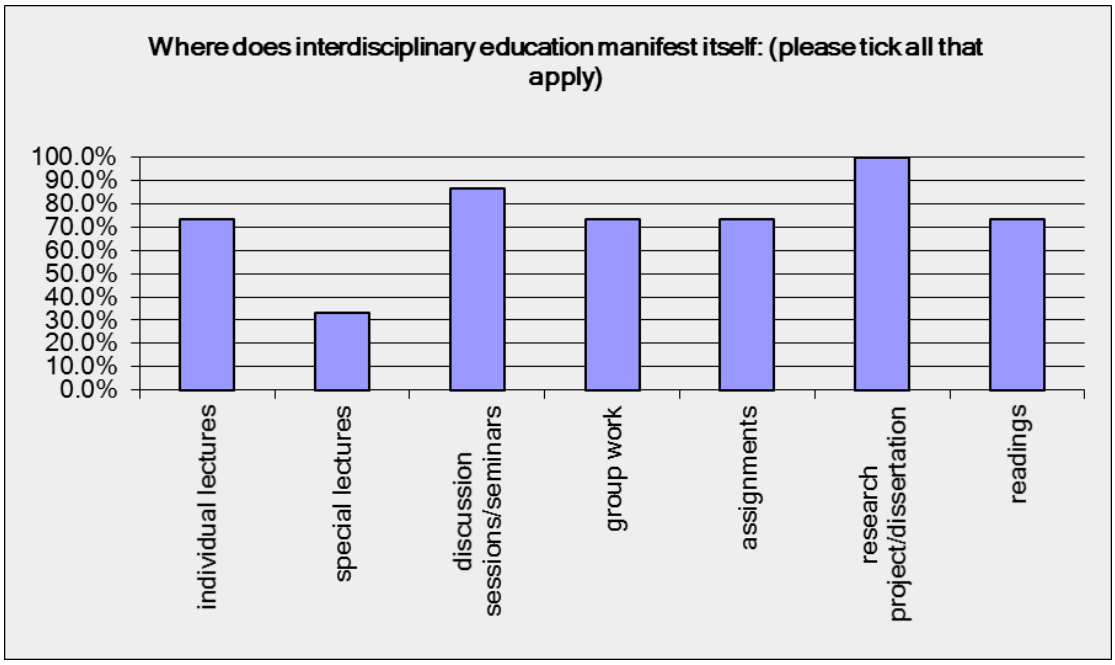
Whatever the technique used for integration, there was near unanimity among programme director respondents that participating academics had collaborated in planning/designing the programme. In terms of actual teaching of the programme, more than two-thirds of the programme director respondents said that participating academics taught both jointly and individually, with just 6% saying they taught jointly and a full quarter saying the academics taught only individually (Chart 4.6).

Chart 4.6: Degree of joint teaching as seen by programme directors



Interdisciplinary education was seen to manifest itself in a range of pedagogical activities, with individual programme director respondents utilising multiple activities (Chart 4.7).

Chart 4.7: Manifestation of interdisciplinarity as seen by programme directors



Learning goals were described briefly in free text by nearly all programme director respondents. Words like "integration" and "connect" were used. Some programme director respondents stressed the necessity of diversity in approaches to tackling complexity in the real world, for example, one

programme "aims to bring different approaches to bear" on key issues, another cites "need for understanding from a variety of perspectives" and another programme's "aim is to address key global challenges, which therefore need the strengths of different disciplines." Other programme director respondents emphasised development of intellectual capabilities, for example, seeking "to develop the conceptual, theoretical and methodological tools" to examine a complex phenomenon. Another programme director respondent noted "the ability to engage with and understand/harness literature and academic modes of enquiry used in different disciplines. Understanding how different disciplinary approaches (e.g. Art) can question, critique and communicate science."

Five innovative pedagogical methods were explored through a survey question. The programmes of roughly half of the programme director respondents make use of:

- 'flipped learning' (with individual students receiving direct instruction in their own time/space and classroom time spent on activities, etc.);
- 'learning to learn' ('double-loop learning' that includes both solving a problem/learning and reflecting on that process).

Some programme director respondents replied in free text to a question asking for any special interdisciplinary competencies gained by students in their programme. Answers emphasised:

- ability to synthesise (e.g. "synthesis", "breadth of academic experience in marshalling complex information/ideas");
- appreciation of diverse perspectives (e.g. "appreciation of different understandings", "the ability to look at a problem from multiple facets", "ability to work across cultures", "receptive to other's views, respect for different expertise, ability to work in teams");
- flexible, critical thinking (e.g. "creativity, reflection", "thinking out of the silo", "abililty to think fast and critically across a wide range of problem solving situations – of very different natures").

There is a sense from our interviews that individuals who develop interdisciplinary provision are 'passionate' about doing so, particularly as they are often pioneering champions working against the status quo:

> There is a small group of (academics) who are the innovators, who think interdisciplinarity is exciting, and some others are really devoted to undergraduate students and think interdisciplinarity is a part of their education. *(ProgDir interviewee).*

Yet, by definition, other academics will often be drawn in who may or may not be deeply immersed in interdisciplinarity. And indeed within one institution aiming for interdisciplinarity, there is likely to be a range of courses; one was described as having "a few close to genuinely interdisciplinary, most multi-disciplinary and some disciplinary reaching out to particular audiences."

Some PVC interviewee comments related to the need for development of staff/good practice, even though the top level of the university may not prioritise this:

> [In academic development] there is a real need for capacity-building in interdisciplinary education. People are pushed and stretched in terms of doing things differently. There is a need for people to come in and work with academics in developing a curriculum to become interdisciplinary. It feels far too big and scary, and academics need a bit of handholding, some real guidance in what it could look like, and practical help in modifying programmes and building new programmes. Once you've got to that point, you can make a business case for staff members to teach more. Just getting off the ground and getting over the inertia (is difficult)… there are some people who are willing -- if we made it easy for them to do, they would say "yes I can see the value in this, let's give it a go", but they are very often shouted down by those saying we (already) have enough to work on. *(PVC interviewee).*

In terms of pedagogical practices, one PVC interviewee observed:

> There can be a slightly misplaced arrogance that if people are doing interdisciplinary research, they can do interdisciplinary teaching. There is a lot to do to help people do this and reflect on it. We don't do enough, although there is some sharing of good practice *(PVC interviewee)*

PVC interviewees did not cite existing formal internal or external staff development in interdisciplinarity, but when asked if there was even an informal 'club' of leaders interested in interdisciplinary education, some PVCs (and programme directors) referred to informal networks where issues and practices are shared across universities (and where external examiners sensitive to issues can be found). "It turns out we are all struggling in the same way." For example, the Interdisciplinary Curriculum Group meets perhaps twice a year; another group, the Combined Honours Network, brings together individuals leading 'combined honours' programmes. While centred in the UK, both have international members. Indeed, liberal arts activity has been increasing within Europe. A new network, ELAN (European Liberal Arts Network) is in the process of being established, and may involve exchanges, workshops and so on. Another international consortium is ECOLAS (European Colleges of Liberal Arts and Sciences). Setting up interdisciplinary provision can be lonely work, with pioneers sometimes feeling like a beleaguered few (albeit growing in number); such an informal group is welcome, as "a collective of like-minded people who can support one another in setting up these interdisciplinary ventures."

There is real interest in various interdisciplinary endeavours learning from each other and in interdisciplinarity becoming much more widely acknowledged as a positive within UK education. As one programme director interviewee reflected:

> Our job is transformative learning, and interdisciplinarity is at the heart of that. We should create as many opportunities as we can. We should not force it into a national curriculum. In some ways it should be a programme learning outcome – to create opportunities to think in different ways… I would like to see the Higher Education Academy try to promote this as a really important virtue of both undergraduate and postgraduate work… I would love to see the research community do studies on this. *(ProgDir interviewee).*

4.5. Teaching challenges and issues

Challenges and issues that arise in interdisciplinary teaching were explored, particularly through free text comments. As a central challenge, interdisciplinary integration is not automatic; it takes effort. Programme director respondents sometimes indicated this in free text; for example:

> In my view interdisciplinarity is exceptionally difficult to operationalise in practice … it is hard work.

> So-called interdisciplinary teaching is much harder to establish than single-discipline. It takes more resources, more time, staff excellence and political will at the point of delivery (not just senior management levels).

Amost three-quarters of the programme director respondents believe that

> it takes significant effort by the leader/management group of an interdisciplinary programme to bring together different fields' epistemologies, theories of knowledge and teaching approaches.

The degree of this challenge is indicated by the fact that nearly three-quarters of the programme director respondents agreed that

> Even when part of an interdisciplinary programme, most academic staff simply wish to teach their usual modules in familiar subjects and not become involved in synthesis.

So, for example, most (80%) of the programme director respondents agreed that it is important to gather participating staff together at least once a year to focus on issues specific to interdisciplinarity. Views were split almost evenly as to the student's responsibility for integration. Nearly as many

agreed (40%) as disagreed (47%) that primarily, it is the student's responsibility to integrate the various contributions of different teachers/modules in the programme.

Assessment can be challenging for interdisciplinary provision. Well over half of the programme director respondents agreed that "assessment of students" work poses a particular problem for interdisciplinary programmes, because assessment criteria for interdisciplinarity have not been developed." However, just over a quarter saw assessment problems arising because "the programme leader has little or no control over questions set/marking done by individual participating academics", with 60% disagreeing. Just over half of the programme director respondents believe that "it is difficult to find appropriate external examiners for interdisciplinary programmes", with a third disagreeing.

'Cultural' challenges also exist, as noted in free text descriptions by some programme director respondents, for example:

> The staff involved (directly, on the ground, as well as at management levels) need to be sympathetic to the different cultures existing in different disciplines – and need to understand those and be prepared to work with/around them (rather than against them). This is not solved by methodologies and is not directly a pedagogical problem, more of a political/cultural one.

Some PVC respondents raised similar challenges with institutional culture change, such as getting people out of their 'silo mentality' and working outside of comfort zones in order to develop an understanding of what interdisciplinary actually means.

Belfast conference survey respondents mentioned a variety of 'cultural' challenges, as well, including: reluctance of academics to co-operate; competition between departments; lack of interdisciplinary approaches to problems among academics and resistance to change. Participants also indicated a lack of awareness about and understanding of interdisciplinarity among students and academics.

Of course, traditional academic culture encourages focus in a single discipline, whether in promotion considerations, administrative structures or required courses of study. As one programme director interviewee captured this fundamental issue of how universities work:

> The challenge relates to a sense of whether multi- or interdisciplinary things are what we quirky people do over to the side, or if this is the air we breathe and what we all do. *(ProgDir interviewee).*

Thus managers of pioneering interdisciplinary programmes find it "difficult to manage when they are the exception" and wonder to what extent they should try to create a mini-university within a university where they do much of the teaching as interdisciplinary provision – and to what extent they should provide a 'point of entry' into various departments, allowing involved students to also engage with a home department (and others) in what a programme director called a "much more murky and hybrid identity."

New approaches can worry students:

> There can be a certain anxiety relating to novelty; students are not sure what is going on; I tell them that is supposed to happen! Then they feel better. *(ProgDir interviewee).*

And, faced with a potential shift in academic culture as well as teaching practice, staff too can worry, as one programme director interviewee describes it:

> I am amazed at the number of staff finding it hard to teach students they are not used to. ("If they haven't done my subject, I can't teach them.") A lot of staff are terrified of that … and also feel "I'm too busy doing what I do, squeezing out time for what I need to do." … There is still a view that if you put too much effort into teaching, it could be a career negative. *(ProgDir interviewee).*

Also, departments may not want to share their good teachers:

> Someone with a known record as a good teacher will be wanted by their department head to teach large numbers in their discipline… Unless the university encourages them with an incentive structure, it is very hard to get a department head to hand over good teachers to a slightly risky experimental project. *(ProgDir interviewee).*

Challenges raised by PVC interviewees include that of 'lip-service' being paid to interdisciplinarity, individually and/or institutionally, without substantive commitment. At the same time, some university leaders might deliberately pose "a certain retardation", for instance, in the face of worrying that "an interdisciplinary undergraduate degree might in fifteen years look like a fad, whereas a discipline degree would have a value career-long."

Many times, interdisciplinary provision appears to have been the results of 'intrapreneurial' activity led by one or at most a few individuals within an institution. Particularly given the weight of tradition, and the known difficulties of culture change, a real challenge lies in embedding interdisciplinary (or other innovative) forms of provision:

> The challenges for all these forms of learning is how you create the structures so they are sustained even when individuals move on. *(PVC interviewee).*

A PVC interviewee noted a disconnect between interdisciplinarity in research and education:

> My colleagues complain about the difficulty of getting suitably qualified PhD students for their interdisciplinary research, but they don't even think about developing them; they expect them to have been magicked up from somewhere. *(PVC interviewee).*

4.6. Administrative challenges and issues

In addition to the sorts of challenges discussed above, when asked what they saw as the most serious challenge or issue facing those hoping to provide interdisciplinary higher education, many programme director respondents cited what could be termed administrative obstacles:

- overcoming institutional barriers – sometimes academic, but more usually operational, which leads those with creative ideas to lose momentum and give up on some very interesting and useful educational provision;
- credits across departments, even within the same college!;
- communication between different departments, including both academics and administrators;
- co-ordinating the progress of approval for programmes and courses across several subject areas and colleges.

Somewhat surprisingly, when asked specifically in a survey question, less than half of the programme director respondents (40%) felt that in administrative terms, "it tends to be difficult to get approval for new interdisciplinary programmes"; most of the other responses were neutral. Only a third (33%) of PVC respondents felt that "it is easier to get official approval for new interdisciplinary modules than for new interdisciplinary degree programmes." Interdisciplinary modules are seen by two-thirds of programme director respondents as having the potential to be "an effective way to pilot educational provision that may develop into interdisciplinary degree programmes." Just under half of the PVC respondents agreed.

Seemingly mundane matters pose problems. Two-thirds of the programme director respondents agree that "sorting out teaching contributions and 'credit' within home departments can be problematic." A third of the programme director respondents are neutral; no one disagreed with this. One programme director respondent provided thoughtful free text:

> Governance processes can be difficult for approval and examination, but funding streams for income can also be challenging. The people putting in the work are not necessarily receiving the income in the subject area. Income generated by students registering can be difficult to locate across several places.

Not dissimilarly, PVC respondents' observations included:

- logistical implications re timetabling, financial allocation of resource, potential concerns among applicants regarding perceived 'dilution' of a degree programme, potential staff concerns in relation to disciplinary identity;
- ensuring coherent collaboration between different disciplines and appropriate match of teaching and examining timetables. Also resource implications;
- true interdisciplinary education requires a different approach with an interprofessional delivery team. Financial flows are the most likely thing to get in the way of this;
- a lack of colleagues in some hard-pressed areas, which can lead to skewing and unequal workload.

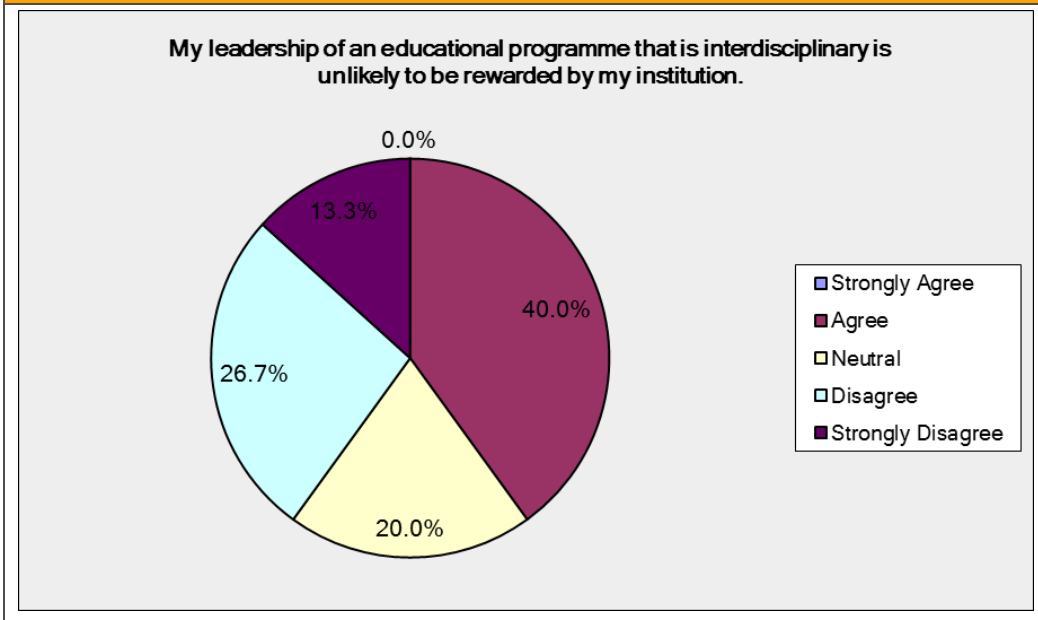
Issues raised by other PVC respondents had to do with assessing market demand among students and indeed among potential employers, for example:

- determining interest of prospective students; organisation and management of programmes;
- getting different teams together. Securing a market for the courses;
- lack of market demand from undergraduate audiences, and a tendency for the market and employers to stick to mainstream subjects that they know;
- we have to be driven by what employers want and often, they want what they understand and are used to. Before we will develop an interdisciplinary programme … we will do a thorough analysis of the market to ensure we are not setting our students up for 'failure', that is, the lack of jobs out there to fit the number of recruits.

For Belfast survey respondents, the largest cluster of obstacles was related to the disciplinary structure of the universities, such that, for example, funding is organised by disciplines and thus situated within a single department. Other challenges identified lie in gaining accreditation for interdisciplinary programmes, particularly when approval is needed from multiple boards. Yet another identified barrier was lack of reference to interdisciplinary teaching in the university strategy. Participants also identified a cluster of 'logistical' challenges, including lack of time and space, lack of assessment standards, large student cohorts and timetabling problems.

When asked if their institution views their leadership of interdisciplinary provision as 'quirky', detached from mainstream education, only one-fifth of programme director respondents agreed, with 40% neutral and 40% disagreeing. Nonethess, a full 40% of programme director respondents believe that their institution is unlikely to reward their leadership of an interdisciplinary educational programme; this is evenly matched by 40% who disagree, with 20% neutral (Chart 4.8).

Chart 4.8: Likelihood of institutional reward as seen by programme directors



A programme director respondent made a related point in free text description of "the most serious challenge or issue facing those hoping to provide interdisciplinary provision":

> Many departments/institutions and external institutions (such as the REF panels) are not designed to support or evaluate interdisciplinary teaching and research. So, the career and institutional incentives tend to work against interdisciplinary efforts, even when there is strong collegial and collaborative feelings among participating staff.

An obvious challenge to interdisciplinarity lies in the divided structures comprising an institution. PVC interviewees cite this, for instance noting a 'balkanised' approach across disciplines, faculties or even campuses. Of course, programme directors run into these challenges head-on, very often stressing not only staff culture but also pragmatic issues. Not surprisingly, money is a powerful factor:

> It is mainly around finance rather than institutional unwillingness. *(ProgDir interviewee).*

Some point out that finance and related administration pose less of a challenge when interdisciplinary provision takes place within the same financial unit, such as a school or even a college within a university. Another suggestion was made that it could be helpful to establish a new centre as neutral ground presumed to be free of disciplinary bias and – particularly if it recruited students and thus income – able to protect any staff from being pulled away to do disciplinary teaching (although this too can cause tensions), as well as offering an accessible vehicle or conduit for new interdisciplinary developments being piloted. Yet, another programme director underscored the value of being housed within a department, with the resources to handle necessities such as examination boards, extenuating circumstances committees and so on.

Sufficient support in the form of resources can certainly be a challenge, perhaps especially in institutions with quite devolved structures:

> There is always a competition for resources; it will be interesting to see what happens in slightly leaner times. I wonder – as schools find resources more pinched – if they will have the confidence to do [interdisciplinary education] instead of what they see as core… There is a long way to go between theoretical acceptance and [actual] change in core composition. *(PVC interviewee).*

Mundane as it may sound, timetabling can be a challenge; for instance, one programme had to design a timetable for its core units while steering clear of mandatory units required by departments for 14 different majors or pathways! Many programme directors would probably resonate to one's comment:

> A lot of things are ludicrously dictated by restrictions in the university. *(ProgDir interviewee).*

Repeatedly in interviews, resources are identified as a key issue by PVCs and programme directors; more than once, support for an innovative interdisciplinary offering is provided by just one person or small office. There is a related issue of the sustainability of even a successful non-traditional offering. One PVC underscored the importance of demonstrating quality assurance for new interdisciplinary offerings, to build credibility for the long-term. On occasion, a university was described as providing real support for interdisciplinarity, not only in research but sometimes in education as well. Some named institutional offices are beginning to reflect this, as in a 'Vice Dean for Interdisciplinarity' in a college of a university.

4.7. Opportunities and advantages

Participation in interdisciplinary teaching can generate real enthusiasm among academics. Nearly all (86%) of the programme director respondents agreed that they and their colleagues "feel a sense of excitement when teaching an interdisciplinary programme", and no one disagreed. Even more (93%) felt that "developing and/or teaching in an interdisciplinary programme has stimulated new thinking in myself/involved colleagues", with no one disagreeing. Again, almost all (93%) believe that "teaching in an interdisciplinary programme has influenced/is influencing the research interests and activities of myself and/or involved colleagues", showing a direct interplay of innovative teaching and research.

Free text comments from programme director respondents include positives relating to creativity such as: "a big increase in creative and flexible thinking", "creativity and thinking in the round rather than relief", "new syntheses, new understandings", "collaboration and knowledge expansion", and "finding new ideas, activities and outputs in the spaces between disciplines." New relationships can emerge: "meeting colleagues who really share your interests and whom you wouldn't meet otherwise." Students themselves are noted as positives: "students who value solving problems beyond the approaches of a single discipline" and "keen students (but who are also very demanding, and very time-consuming because of the very complex nature of the degree)."

Intellectual benefits exist for students, as seen indirectly through the informed perspective of programme programme directors. Nearly all (93%) of the programme director respondents "feel proud of the intellectual development shown by students taking the programme." More than three-quarters (79%) of the programme director respondents agreed that "students feel a strong sense of identity with the interdisciplinary nature of the programme." PVC respondents cited intellectual advantages for students, such as:

- [it] encourages intellectual agility;
- by making students consider a different paradigm, a different way of thinking, we enhance their cognitive skills and are more likely to create effective critical thinkers and problem solvers than by conventional approaches to course design;
- I feel that it is a fantastic opportunity to work in collaborative teams to address challenges without borders. It can stimulate new thinking by enabling the sharing of diverse ideas, approaches and experiences;
- the chance to explore new learning and new roles.

More than three-quarters (79%) of the programme director respondents agree that "prospective employers have expressed positive interest in the way my interdisciplinary programme is preparing its students for employment." Indeed, many of the PVC respondents commented on employability in the broadest sense; as one said, interdisciplinary higher education is "a reflection of reality." Advantages include

- recasting the disciplines to reflect the real world and learner interest;
- exciting opportunities for students, staff and the wider community regarding knowledge creation and transfer, support for complex skills development in students leading to enhanced employability, and an enriched learning community;
- a graduate population much better equipped to thrive in the real world;
- meeting the needs of the stakeholder, students and employers;
- the development of cutting edge degree programmes that are attractive and relevant to students and the real world;
- preparing students for a dynamic future.

Some PVC respondents referred to benefits for the institution, for example:

- the opportunity to develop interesting provision for new markets;
- more interesting, better educated students;
- a more dynamic and interesting curriculum - although also a more challenging one;
- the opportunity to develop modules/programmes that are truly interdisciplinary (i.e. not just two disciplinary silos);
- creating new opportunities for prospective students and sharing best practices;
- the potential for collaboration;
- research and teaching benefits from the synergies between different subjects and responding to a clear demand from appropriately qualified applicants;
- research impact;
- MOOCs.

Belfast conference respondents provided brief survey input as to multiple incentives for interdisciplinary educational provision, with the most important in their eyes being institutionally-

based, emerging from university strategy and departmental priorities; a related institutional incentive would be attraction of funding. Support from colleagues and superiors would make participants more willing to undertake interdisciplinary programmes. In terms of educational outcomes, employability of interdisciplinary graduates was seen as an incentive, along with, for example, better quality and breadth of education.

Interviewees often see a connection between interdisciplinary education and useful career skills or capabilities – even though this connection may not be particularly evident to many academics used to thinking in traditional ways about providing students with discipline-based content. Programme director interviewees comment on the changed nature of jobs and careers for graduates today, who are likely to change jobs many times and to have 'indeterminate job titles' compared to past generations. As PVC interviewees observed:

> What we do know is that employers are saying they want young people who can think in different ways. Fewer are working with factual knowledge they have gained in their degree; they are using skills acquired instead of factual knowledge. [But] we don't focus as educators … on what skills do you need to demonstrate to people if you want to or need to move between jobs and careers. Universities are very slow in recognising there won't be one job to age 65 … academics are really poor at understanding the skills that young people need to acquire as they go out in the world. *(PVC interviewee).*

> Are universities the foundry for information assimilation or skills generation? *(PVC interviewee).*

Some see interdisciplinarity as fundamental to understanding and operating within the world:

> There is no other reality than interdisciplinarity; you simply couldn't do without it. *(PVC interviewee)*

Benefit to students as individuals pursuing satisfying careers is clearly an aim for most programmes. Thus, as one programme director observed, drivers for interdisciplinary programmes can include:

> intellectual drivers – the joy of knowledge, recovery of the university as a place for learning and curiosity … employability – students becoming a bit more worldly, wiser, more au fait with complex issues … a social responsibility agenda, so that courses also encourage students to think critically about social and ethical responsibilities … market – other universities in the world are doing this. *(ProgDir interviewee)*

And another commented:

> If you discuss so-called 21st century learning skills, like creativity, communication, collaboration – these are all skills students acquire in doing interdisciplinary work, even at the Bachelors level. *(ProgDir interviewee)*

Referring to the utility of an interdisciplinary education, another interviewee said:

> We want everyone to have the 'aha!' moment for themselves, seeing what they can contribute (as a result of their education); you never know when it will happen for them.

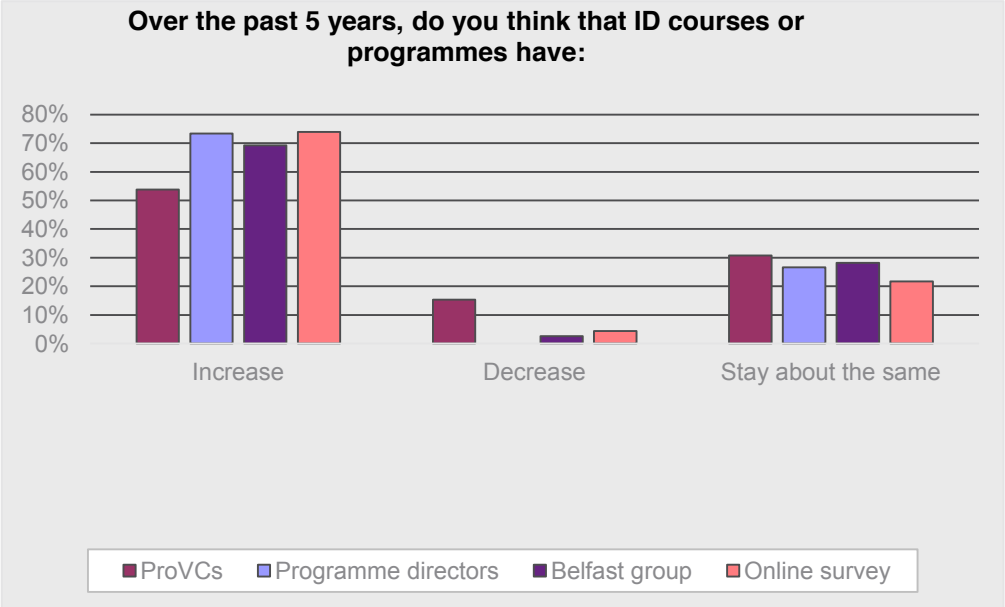
And, of course, programme directors in particular hope that students will have a distinctive, satisfying and even enjoyable learning opportunity. So, for example, one programme director observed:

> Students like… studying with people they would never otherwise meet. That produces conversations and dialogues that simply wouldn't occur otherwise; students are surprised at how students in other disciplines think. *(ProgDir interviewee)*

4.8. Institutional trends

Informed views were sought to provide insight into past and upcoming trends. When we look across our combined datasets[28] (Chart 4.9), a majority of respondents claim that the number of interdisciplinary courses in the last five years has increased. Around a third of them say that it has stayed the same. While only a few percent of the respondents from the three groups (programme directors, Belfast group, and online respondents) claim that the number of interdisciplinary courses has decreased in the last five years, 15% of PVCs record a decrease.

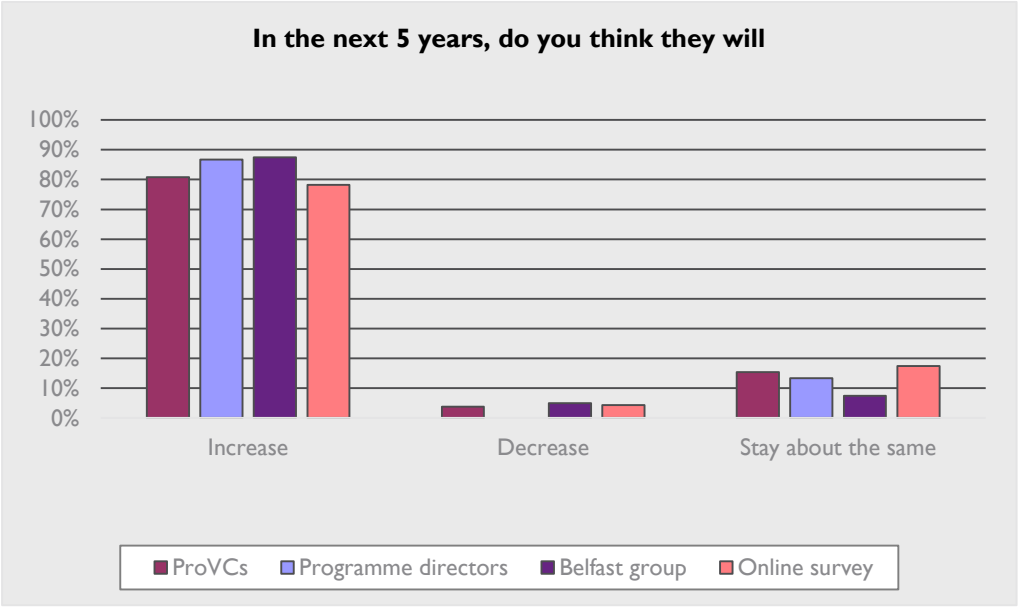
Chart 4.9: Trends over past five years (full dataset, *n* = 112)



Looking to the future, within our combined dataset, respondents believed that in the next five years the number of interdisciplinary courses will increase (Chart 4.10). This view was shared by around 80% of respondents from all four groups. Between 8% and 17% of respondents claimed that the number of courses will remain the same, and less than 5% claimed that it will decrease. The two groups that were the most optimistic about the future of interdisciplinary courses were the Belfast group (88% believing the number of courses will increase) and programme directors (87% believing in the increase).

[28] PVCs, programme directors, online surveys and Belfast conference participants (*n* = 112)

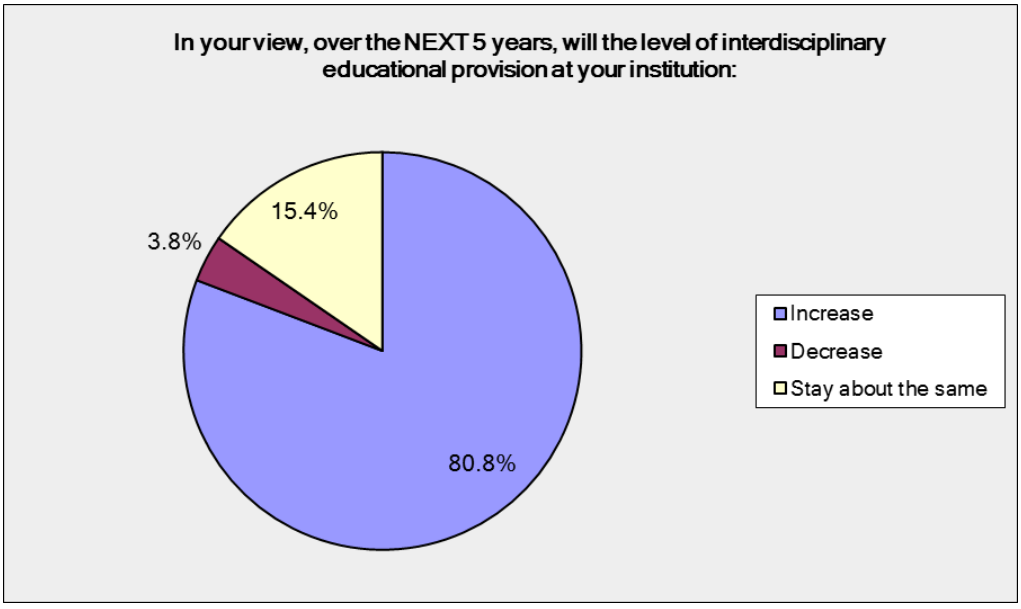
Chart 4.10: Trends in next five years (full dataset, *n* = 112)



Turning now to the individual datasets, when PVC respondents were asked about possible changes over the past five years in the level of interdisciplinary educational provision at their institution, just over half thought the level had increased (Chart 4.11). Nearly a third thought it had stayed about the same and only 15% thought it had decreased. A higher percentage of programme director respondents, nearly three-quarters, thought that such provision had increased at their institution, although a quarter believed it had stayed the same. Very much like the programme director respondents, the majority of Belfast conference survey respondents believed that the number of interdisciplinary courses in the last five years has increased, with 28% believing it has stayed the same.

Looking to the future of interdisciplinary educational provision at their institution in five years time, most of the PVC respondents expect the level to increase, with nearly all the rest expecting it to stay the same.

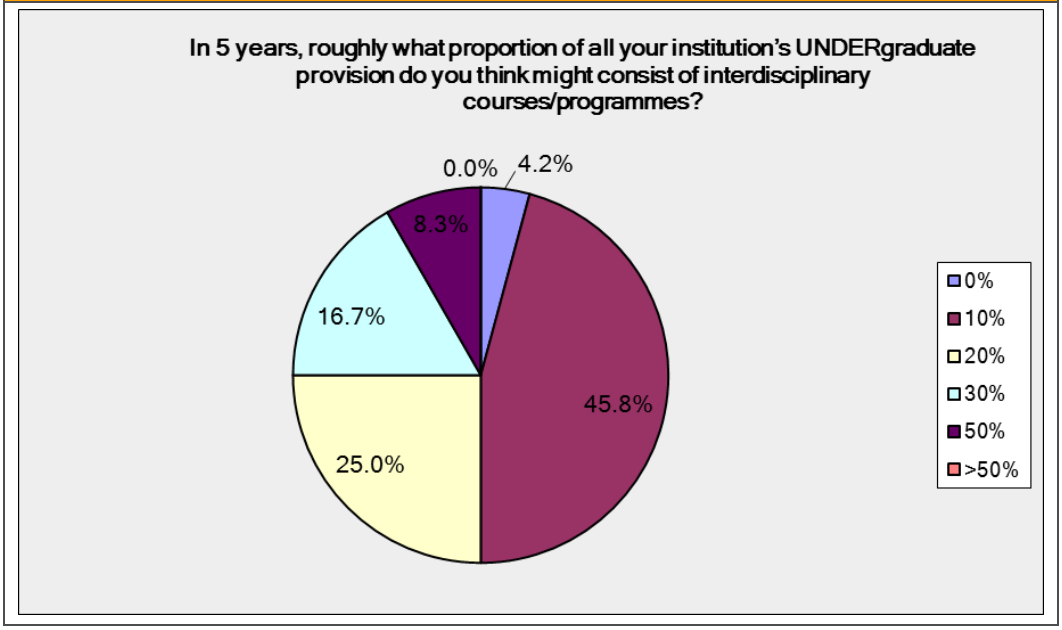
Chart 4.11: Expected level of interdisciplinary educational provision, as seen by PVCs



Even more (87%) of the programme director respondents expect an increase over the next five years. Again, this is very much the same proportionality as that of the Belfast conference survey respondents, 87% of whom expect an increase.

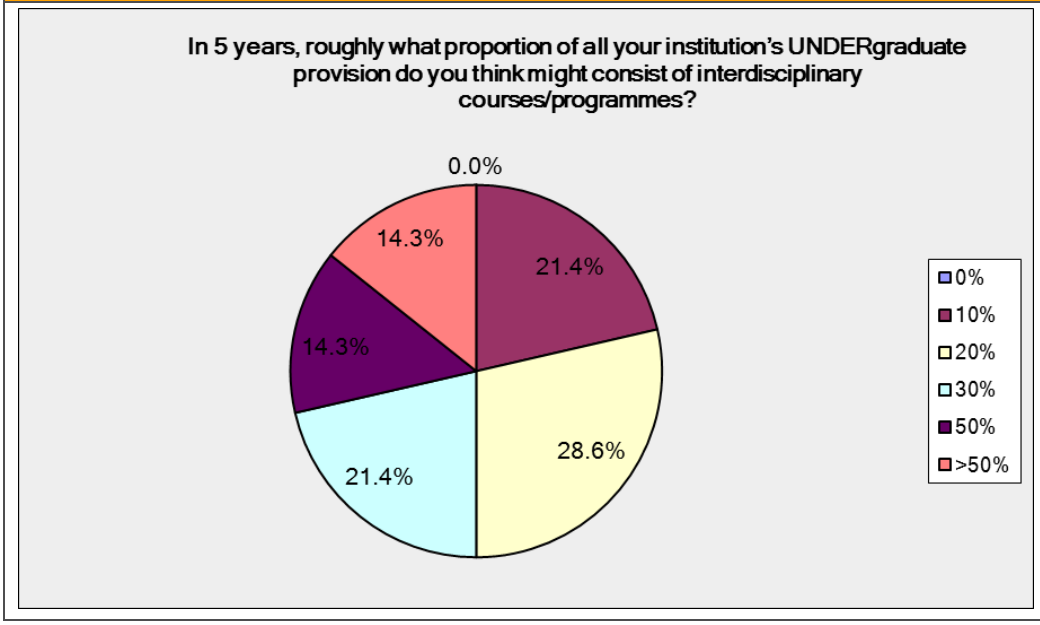
More specifically, PVC respondents were asked to think about five years from now and estimate the likely proportion of their institutions' undergraduate provision that might be interdisciplinary courses/programmes. Only a quarter of the PVC respondents estimate that more than 20% of undergraduate provision will be interdisciplinary. More saw it as comprising 10% of the undergraduate provision than selected any other percentage. No one saw more than 50%, and just 8% saw as much as 50%; even 30% of future provision was seen by only a small fraction of PVC respondents (Chart 4.12).

Chart 4.12: Expected proportionality of interdisciplinary undergraduate provision as seen by PVCs



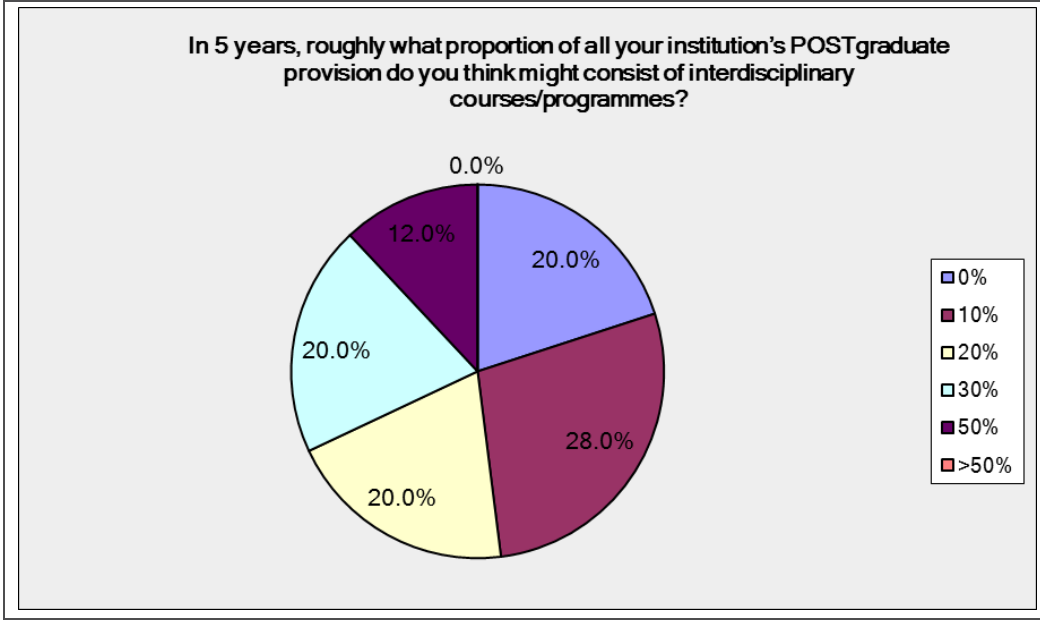
Enthusiasts that they are, programme director respondents envisioned a much higher proportion of interdisciplinary undergraduate education in five years. Programme director respondents were evenly split between those expecting 10% or 20% of their institution's undergraduate provision to be interdisciplinary, and those expecting it to form 30% or more of the undergraduate provision. Indeed, more than a quarter expected it to form 50% or more (Chart 4.13).

Chart 4.13: Expected proportionality of interdisciplinary undergraduate provision as seen by programme directors



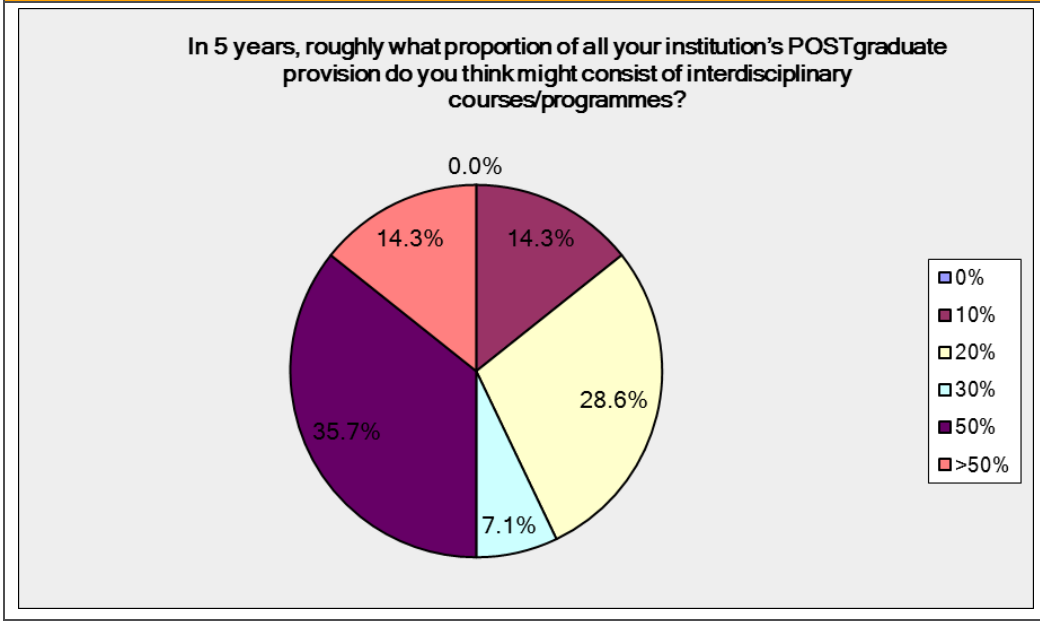
Respondents were also asked to estimate the proportion of their institution's postgraduate provision that might consist of interdisciplinary courses/programmes. A full fifth of PVC respondents predicted that none would be interdisciplinary while a third expect it to be 30% or more; none of these predict more than 50%. In between, a fifth of the PVC respondents predict interdisciplinarity will comprise 20% of postgraduate provision; even more of the PVC respondents predict that interdisciplinarity will comprise merely 10% of provision (Chart 4.14).

Chart 4.14: Expected proportionality of interdisciplinary postgraduate provision as seen by PVCs



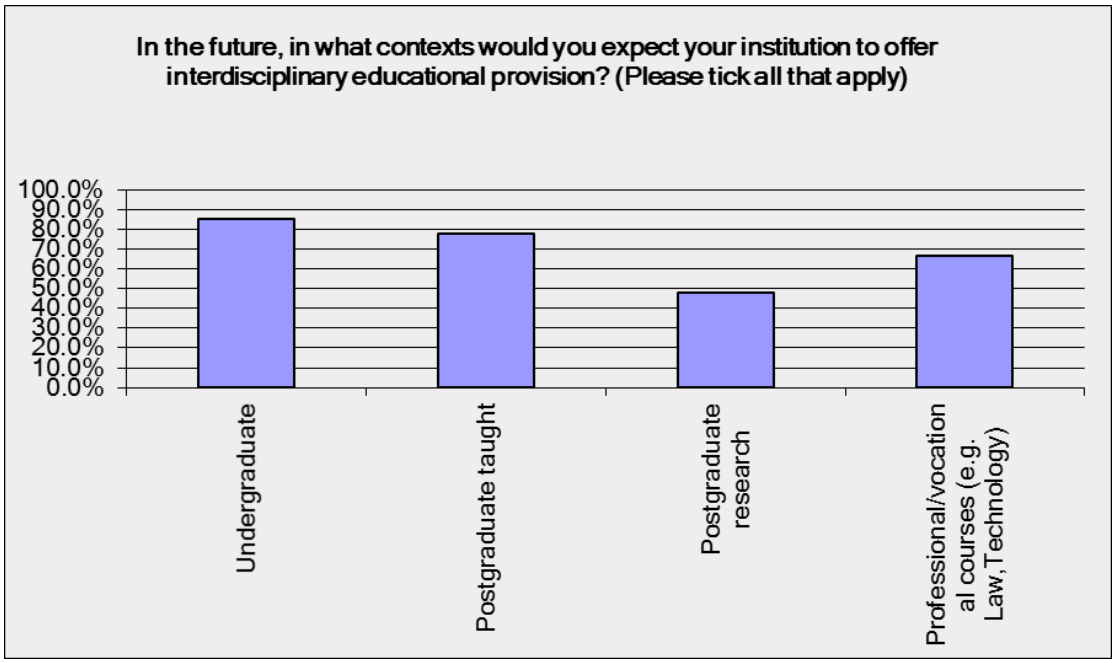
Among programme director respondents, there is again a higher expectation regarding proportionality of interdisciplinarity at the postgraduate level, with more than half predicting 30% or more and less than half of the programme director respondents predicting 10% or 20%. None predicted 0%. Interestingly, half of the programme director respondents even predict interdisciplinary provision to form 50% or more of postgraduate provision (Chart 4.15). This is almost double the proportion with that expectation at the undergraduate level.

Chart 4.15: Expected proportionality of interdisciplinary postgraduate provision as seen by programme directors



PVC respondents were asked in what contexts they would expect their institution to offer interdisciplinary educational provision in the future. Selecting all that they felt applied, the highest percentage of PVC respondents selected undergraduate provision, quite closely followed by the 77% selecting taught postgraduate provision. Interestingly, just under half expected this in the context of postgraduate research, but a full two-thirds expect it in professional/vocational courses (Chart 4.16).

Chart 4.16: Expected contexts for interdisciplinary offerings as seen by PVCs



Perhaps the most striking differences between PVC respondents and programme director respondents lie in the latters' generally greater expectations (100% of respondents) for postgraduate education (taught or research), and far lower (47% of respondents) expectation for interdisciplinarity in professional/vocational courses (Chart 4.17).

Chart 4.17: Expected contexts for interdisciplinary offerings as seen by programme directors

Although the focus of the surveys was on interdisciplinarity occurring at the level of a programme, the overview of PVC respondents was also drawn upon to gain a picture of interdisciplinary provision in the form of modules. When asked, half of the PVC respondents agreed that there are more interdisciplinary modules than interdisciplinary programmes at their institution (only 19% disagreed). Somewhat fewer, 41%, believed they were seeing an increase in proposals for interdisciplinary modules (30% disagreed).

In terms of student demand, a programme director interviewee noted that their institution's interdisciplinary provision stemmed from:

> a mix of inspirations – a general sense of a certain dissatisfaction among many students about the complete specialisation of an Honours degree and beyond that certain constituencies of students with particular interest in interdisciplinary degrees, such as international constituencies already thinking about interdisciplinary degrees and perhaps seeing specialised UK degrees as an outlier. *(ProgDir interviewee).*

Some PVC interviewees have the sense that interdisciplinarity (and other themes) appear to be a 'growth area', with some universities moving somewhat in that direction. Some institutions are seeing staff, perhaps especially young staff, coming forward to teach new interdisciplinary courses. Yet, the extent of student demand is not known:

> We are just at the stage where people are becoming aware that these kinds of degrees exist, so we are not hitting the ceiling yet but it is hard to know how many people will want to do this. *(PVC interviewee).*

Indeed some PVCs see interdisciplinary as a vital component of preparing graduates for the world of today/tomorrow:

> …a real sense that interdisciplinarity is the only way universities are going to survive in the real world, by producing much more rounded graduates who have broader skill sets and are less fixed in their mindset as to who they are and are not, what they can and cannot do … some universities are taking notice. *(PVC interviewee).*

And, painting a picture on an even broader canvas, some would suggest that interdisciplinary education plays a profoundly intellectual role:

> We moved away from the idea of having polymaths a long time ago. As an academic nationally the idea of being a generalist is an insult; it is used as a derogatory term. There is a sense in which we are trying to reclaim the notion of deep generalists, people who are true polymaths with a breadth of interests … able to converse in the language of more than one discipline. We don't value that sufficiently. *(PVC interviewee).*

Even among PVCs seen to be open in principle to the idea of interdisciplinarity, there is still "nervousness at abstract pedagogy." There is a tension between depth and breadth. One PVC suggested, for instance:

> At the Masters degree, there is no harm if education is not deep, but if it is at the undergraduate level, it is better get into nuts and bolts (and serve an) apprenticeship to be master of a discipline before an individual can be let out into the world to be interdisciplinary. *(PVC interviewee).*

Beyond nervousness, some institutional leaders fail to stand behind innovators:

> A small number of absolutely visionary academics have brought about change in their own institution, but they are having a terrible uphill struggle. If your institution is, frankly as mine is, paying lip service to interdisciplinarity -- (leaders) are sure it must be a good idea but are not showing any willingness to make academics do something different, it won't happen; then they wring their hands and say "it's not happening". (Support is needed) at the top, instead of "marvelous, probably not a priority. *(PVC interviewee).*

One programme director interviewee illustrated management conservatism by recounting that, when trying to encourage a dean to embrace interdisciplinarity, saying "we could be ahead of the wave"; the dean replied "I was thinking more, we'd like to be just behind the wave."

In addition to pragmatic challenges discussed below, some issues countering a rise in interdisciplinarity, making it seem risky to explicitly promote interdisciplinary degrees, spring from typical secondary school preparation of students and indeed the traditional, risk-averse attitudes of parents:

> Students have been channelled into a narrow area … and become quite rigid in their thinking. Undergraduates want a clear and coherent course that will lead to a qualification that is recognised. They are very heavily influenced by their parents. *(PVC interviewee).*

Interestingly, more than one interviewee saw a connection between students who had taken an International Baccalaureate programme in secondary school and who were interested in interdisciplinary provision at university:

> They are broader, more intellectual people, with a broad range of skills, who see the world a little differently; they are going to be better suited to a modern and rapidly changing world than the ones who didn't have the boldness at 6th form to try something different. *(PVC interviewee).*

There can be a real tension between university expectations at different stages:

> Universities can be very traditional as to which A levels count, and very suspicious of anything that looks like a broad A level, but … we get preoccupied about them getting broad when they leave university. *(ProgDir interviewee).*

In designing undergraduate experiences, opinions differ as to the degree to which synthesis is achievable. One view is that integration should be done for the students:

> For most undergraduates, asking them to integrate across disciplines in their own heads is quite difficult. *(ProgDir interviewee).*

Yet others would suggest that, especially as they begin their studies, many students simply desire a 'combined degree' that allows them to study two subjects in which they are interested, "leaving them

separate in their heads." One such programme director interviewee does offer an interdisciplinary strand in the last year, for which some students choose to do interdisciplinary projects and do them very well:

> It may well be that these are the students who have already started to synthesise in their heads and are able to bring together synoptic projects. *(ProgDir interviewee).*

4.9. Professional capacity-building

In the face of likely trends toward at least some degree of increase in interdisciplinary provision, questions were explored as to the extent to which academics, academic development and academic leadership staff are prepared for such changes. Nearly all PVC respondents agreed that "it would be helpful for me/my office/academic staff to have access to a body of good practice in interdisciplinary provision" (Chart 4.18). Strikingly similar views came from programme director respondents, of whom the same proportion believed that "it would be helpful for me/associated staff to have access to a body of good practice in interdisciplinary provision" (Chart 4.19). This desire contrasts sharply with current reality. When asked if staff development at their institution explicitly included interdisciplinary teaching, only a quarter of programme director respondents agreed, while twice that disagreed. Only a third of PVC respondents agreed, with a third disagreeing. A higher proportion, although still less than half (44%), of PVC respondents agreed that some of their academic staff had attended workshops or other staff development courses elsewhere to learn about good practice in interdisciplinary provision. Only a fifth of programme director respondents said that they or other academic staff associated with the programme had attended workshops or other staff development courses elsewhere to learn about good practice in interdisciplinary provision.

Chart 4.18: Desirability of access to good practice as seen by PVCs

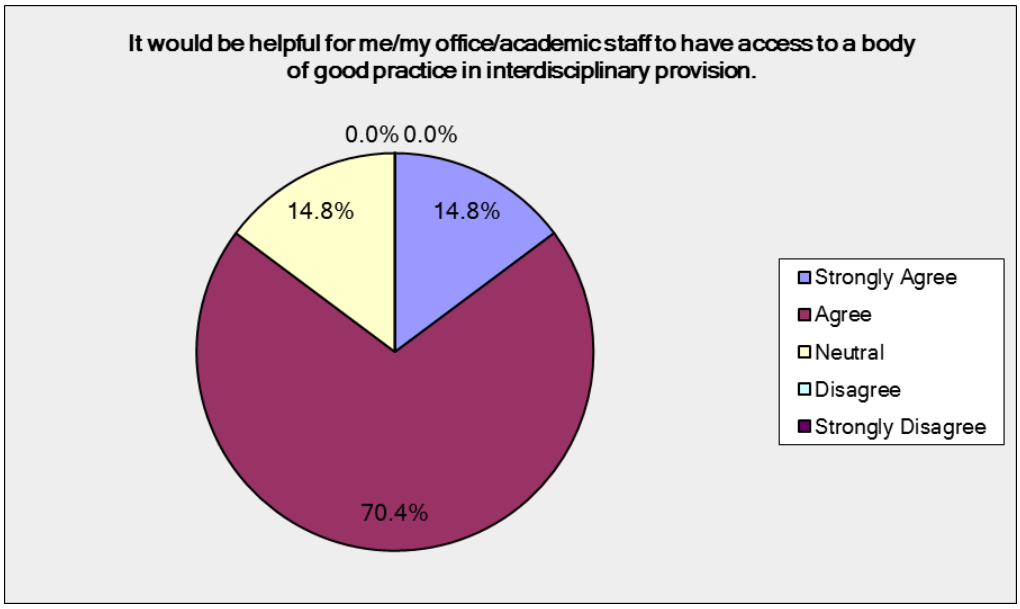
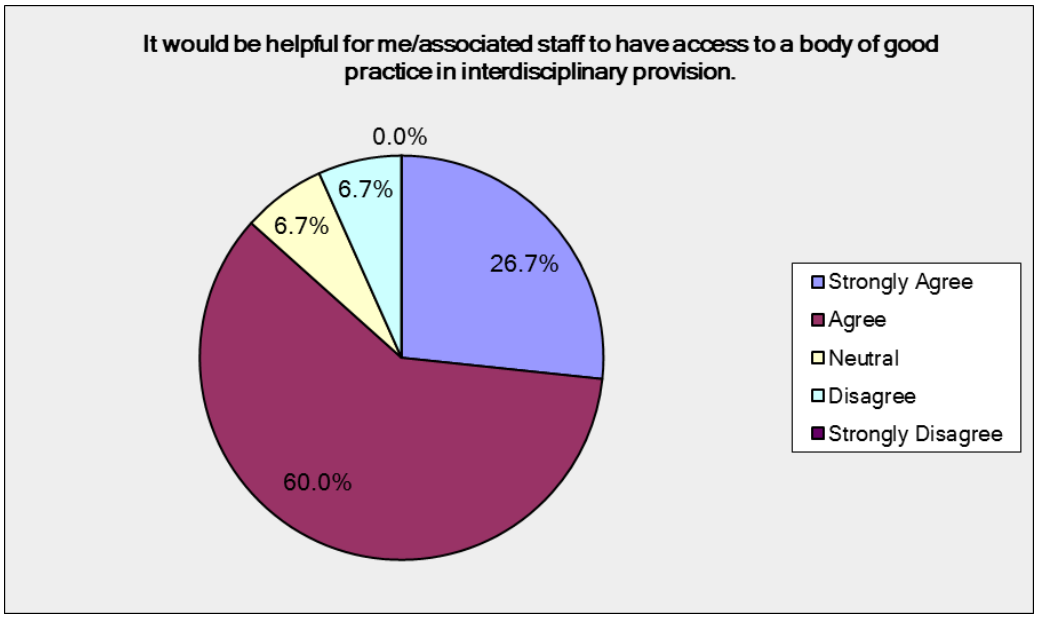


Chart 4.19: Desirability of access to good practice as seen by programme directors



Belfast conference participant respondents shared their thoughts as to support that would help them be more effective in interdisciplinary teaching. Access to research and good practice (for example, in the form of case studies or showcases) was emphasised. Another important area is support in skills development, for example, through organisation of masterclasses or tutor training. Funding for trials and test projects was mentioned. Some participant respondents underscored the importance of institutionalised support, for example, in university strategies, through institutional reforms or through the inclusion of interdisciplinarity in PGCHE provision.

4.10. Lessons learned

Survey respondents and interviewees were asked to share 'lessons learned' through their experiences with interdisciplinary provision, to help others hoping to develop an interdisciplinary programme. There is clearly an opportunity for innovative academics to learn by doing: for example, well over two-thirds (72%) of the programme director respondents agreed that "the design of the programme has evolved over time; participating academics have learned valuable lessons about interdisciplinary provision", and indeed more than a quarter (29%) strongly agreed. Programme director respondents shared some 'lessons learned' from working on their own programmes, while PVC respondents provided lessons learned from their bigger picture perspective. Highlights are provided here and further, verbatim quotations are included in Annex F.

4.10.1. University structures, politics and administration

With regard to university structures, politics and administration, PVC respondents offered messages tending to fall in the categories of:

- the need for consultation and development of supporters at all levels (students, staff and university leaders);
- the need for evidence of demand/validity of a proposed programme;
- the need to address logistical and cultural challenges.

One PVC's pithy response of 'perseverance' was fleshed out by another PVC respondent who captured a full range of necessary steps:

> The proposal needs to meet University strategic objectives and not be a personal 'hobby'. You need to be able to demonstrate its advantage both to the university and the future students. You need to work with the colleagues in the different disciplines and pull together a coherent but multidisciplinary course team. You need to have all relevant Deans on board and to have worked out how the finances will work, the QA and the reporting. Also, you need to ensure that your student record system can cope!

Programme director respondents offered thoughts including planning and development but also the need to realise that their commitment may not be widely popular. One programme director respondent captured what can be an uneasy balance of perseverance and agility:

> Be patient and stubborn (but still open to dialog and opportunity and flexible?).

4.10.2. Good practice and/or pedagogical methods

PVC respondents offered messages as to good practice and/or pedagogical methods, with comments encouraging attention to the particular features of interdisciplinarity and the role of leadership in building a collaborative teaching initiative. Being aware of the different pedagogies used in the different disciplines and not denigrating the practices of a different discipline is key. Several took the opportunity to commend advantages of effective interdisciplinary education. One thoughtful PVC respondent wrote, for example:

> At our institution many feared that interdisciplinary initiatives would lead to the dissolution of disciplines. In fact, the opposite has been the case. Interdisciplinarity has showcased the different qualities of each discipline by placing them in contrast. It has been tremendously instructive in helping us to understand what disciplines have in common and where they diverge.

Programme director respondents placed particular emphasis on the roles to be played by the leader developing the programme, as well as practical suggestions for teaching. One respondent highlighted the importance of really understanding team members' perspectives:

> Our interdisciplinarity really began to gel when we had a joint academic project … the project forced us to work together in ways that we hadn't really done before, even in putting the programme together. It ensured that science and humanities expertise genuinely combined and we understood much more about each other's practice, which I don't think we had fully done in putting the programme together. It meant that there was genuine academic thought about the interdisciplinary subject, not simply addressing QA issues and programme management.

Additional thoughts as to good practice and/or pedagogical methods were offered by Belfast conference participant respondents. Among these are recognition of the potential for confusion when challenging disciplinary assumptions. This demands hard work with colleagues as well as students, in order to break down barriers while also constructing something positive in a way that helps students appreciate the benefits of interdisciplinarity. There was a view that interdisciplinary courses cannot be learnt through traditional approaches but require practical student engagement.

4.10.3. Guiding principles to underpin high-quality interdisciplinary provision

PVC respondents offered some guiding principles to underpin high-quality interdisciplinary provision. Along with taking care in planning processes that incorporate equality of respect for different disciplines involved, coherency of the offering was a key message, for example:

> Make sure that the course makes good educational sense and that the mix of modules provides a coherent programme.

Programme director respondents' guiding principles to underpin high-quality interdisciplinary provision, included both its development – and the importance of vision and engagement of colleagues – and principles for engaging with students.

5. Effective approaches to promoting, evaluating and sustaining interdisciplinarity: case studies

Summary

Drawing on our interview data, this chapter offers six case studies of effective approaches to promoting, evaluating and sustaining interdisciplinarity. The experiences captured span:

- an innovative extracurricular experience in interdisciplinary project teams;
- piloting an interdisciplinary module;
- a new interdisciplinary undergraduate degree programme;
- a professional education PGT Masters degree;
- a liberal arts undergraduate programme bridging Arts and Sciences with a major, a minor and interdisciplinary core modules;
- an example of top-level, institutionalised support for interdisciplinary undergraduate education at a major US university.

Case study 1: Innovative extracurricular experience in interdisciplinary project teams

Title/institution
'AcrossRCA' http://across.rca.ac.uk/ Royal College of Art
Provision level, numbers, area
Postgraduate (most participants are two-year Masters students) 450 students took part in a project in 2014 Art and Design
Nature of interdisciplinary provision
Extracurricular week-long experience: interdisciplinary project teams
Development
The Royal College of Art has a long-held philosophy of 'art in a design context' and 'design in an art context', but teaching is very much School-based. Student demand has led to an experiment in integration, AcrossRCA, run by the Academic Development Office. AcrossRCA "is a week-long programme of cross-disciplinary working at the RCA, bringing together students and staff with different expertise, interests and perspectives to collaborate on a wide range of briefs set both internally and by external partner organisations." Students and staff are given the opportunity to define projects; groups are formed from the projects selected. For example, there were some two dozen projects in 2014, with wide-ranging topics including: Celebrating Neurodiversity, Mapping the Invisible City, Rapid Response Creativity, Sensing and Trapping, Art Writing and Designing with People. (Examples of past projects can be seen at http://across.rca.ac.uk/) AcrossRCA was piloted in 2010, with 11 projects for which 228 places were available (some 290 students applied). Although initially an experiment, success has made it an annual event, for which numbers have 'skyrocketed'. In 2014 there were 450 places available (with some 750 applications) for 23 projects. Project group size has also grown over time from ten to an average of 25, with some as large as 50. A small budget makes it possible to provide students with modest funds for materials costs, fees for visiting lecturers and so on. The students are postgraduates (average age of 28) and very motivated; when participating in an AcrossRCA project, they "hit the ground running and tend to throw themselves into it."

AcrossRCA is now something "everyone knows about and gets excited about – or gets disappointed if they did not find a place. In a very short period of time, it has become part of the landscape'.

Challenges/opportunities

Challenges:

The initiative has been "so clearly led by student demand, there is a struggle as an institution as to how we can respond to that, while working within the institutional structures we are comfortable with." As anyone in an institution could easily imagine, not only was gaining agreement to the concept of a single week where "normal business would stop" difficult, but actually pinning down an agreed week was "challenging"! Once agreed, that same week in early November has been used every year.

With growing popularity, students have had to be turned away. Since AcrossRCA is referenced in some handbooks, students who do not get to take part can feel that they have a "diminished experience." Priority is given to students in the second year of their Masters programme.

Participating students have also been frustrated that there has not been any follow-up to the week. To address this, AcrossRCA 2015 will conclude with a 'Pass it on' event that encourages participants to reflect on, celebrate and share what was achieved.

The future of the experience needs to be considered; for example, should it be credit-based and, if so, would it still work to have students running some of the projects, even carefully scrutinised as they already are?

Opportunities:

Students are extremely enthusiastic about the experience, as seen both by the rise in demand and by feedback from an internal evaluation, in which it was clear that students valued working with other students from varied departments, with different points of view and approaches to problem-solving.

Lessons learned

"The big fear was that it would lead to blurring of lines and thus diminish the disciplines. It has not! It has demonstrated differences and commonalities between areas … Students really appreciate the opportunity to see what the differences are, as they work together, not just talking in the bar."

"People's flights of fancy can be incredibly productive, recognising ideas across approaches; finding those connections is incredibly exciting."

"It takes a long time and we can be conservative as institutions, but it is important to keep listening and put in significant management grind to come up with something that satisfies both students and academics."

Case study 2: Piloting an interdisciplinary module

Title/institution
Living Lab www.edinburghlivinglab.org University of Edinburgh
Provision level, numbers, area
Undergraduate module and counterpart postgraduate module Cap of 40 students for undergraduate module Sustainability, traffic
Nature of interdisciplinary provision
New undergraduate module (following piloting of a module within a Masters programme), emphasising interdisciplinarity in real-world problem-solving by teams
Development
As described on its website: "Edinburgh Living Lab is a new collaborative initiative between researchers, the public sector and industry. It is radically interdisciplinary and comprises a set of resources, knowledge, tools and relationships that will develop over time." The academic leads have been developing this idea for teaching and learning as well as research. Working with an MSc programme, with half of the students from Design and half from Informatics, they wanted to provide an experience for the students to learn to work together across disciplinary boundaries by providing them with a common, external challenge. "We had the idea we wanted to get them to learn to engage with real-world problems and see how they were interdisciplinary in nature … We wanted to use a design approach, and work with novel data and evidence, where the students learn that these always emerge from and respond to real-world socio-political processes." The pilot involved working with a local neighbourhood organisation of the Edinburgh City Council and others. One of the key neighbourhood policy challenges is improving active travel; students were asked to observe and talk to the community, gather data and make and test a design intervention. They faced something new together and discovered their complementary skills. One example involved experienced and less experienced cyclists wearing Google glasses to gather data at a tricky roundabout. Presentations with local activists and councillors at a community meeting on cycling "opened their eyes a lot – it is a lot messier in the real world." Following the successful pilot, the University provided a Principal's Teaching Development Fund grant to develop an innovative undergraduate module and its assessment more fully. Data Design and Society (undergraduate module) and Society, Data Design and Social Innovation (postgraduate module) are being run from the School of Informatics and the Edinburgh School of Art respectively, but with the former intended to attract undergraduate students from across the University. Each year the module will focus on an externally set challenge, possibly transport and sustainability again, but future topics will draw from other 'grand challenges', such as aging or energy. This makes it possible to develop relevant data, tools, resources and a network of outside speakers and advisors that all student groups can engage with. Together, the projects developed within any one year's module represent diverse approaches to a common problem, which can be presented as a coherent set of ideas to people outside the University. The core is "learning and developing through a living lab – going out into the real world, finding ways to understand that world, trying things out to make an intervention and then evaluating it in some way." It is not about finding a solution to a challenge, but learning how to engage with the real world and propose new ways of seeing and approaching difficult, interdisciplinary, political issues by making interventions. This draws on a 'Learning by Developing (LbD)' pedagogical approach, through which students engage with the world beyond the University:

"using different learning outcomes, modes of teaching, and methods for assessment … A key element of LbD at Edinburgh University is an interdisciplinary approach, with project teams made up of students from different disciplines, each bringing their own expertise, learning to work together, understand and respect the knowledge of others, and work out how their own knowledge and skills can contribute to the joint project. For example, biological scientists, sociologists, lawyers and energy engineers may work together on projects to do with renewable energy."

(See: www.edinburghlivinglab.org/learning-by-developing/)

These are viewed as essential skills and mental attitudes required for the modern world, where we are likely to be working with others with different skills to ourselves.

The module provides core classes, personal mentoring and online resources. It is effectively at a 'proof-of-concept' stage, trying to demonstrate to the University the value of this unusual approach. As well as further development of the module itself, effort is needed to get this type of module more readily accepted by the administration, in order to deal with timetabling, space in the curriculum, physical spaces and so on. The Student Association is very keen to help lead this change.

Challenges/opportunities

Challenges:

There are a range of challenges, such as assessment, timetabling, organisational constraints, cost and skills of mentoring, and relationship with outside organisations. The time intensive modules involve personal mentoring and interactive classes, which are engaging for lecturers, but are probably financially unsustainable, so PhD and PD assistants need to be trained. Teaching is usually organised by departments rather than centrally, and there are problems with transfer of money and time, when both students and teachers come from different schools. Interdisciplinary classes also challenge overburdened timetables – space needs to be made across curricula and schedules.

There can be challenges with assessment: how can this be done in a way that is appropriate for different students and the home departments for which they need credit.

Practically, too large a set of projects could be difficult to manage, in terms of student numbers, bringing in external partners and resources and so on.

Opportunities:

This innovative module, emphasising interdisciplinary teamwork in addressing real problems, fits very well with the University's emerging strategy for Teaching and Learning, and the demands of the student body.

It is a question of harnessing students to explore different ways of seeing the problem (rather than solving the problem, which would require a certain set of skills). "Whichever group of students you get will reflect what they bring … We want students who can go out and say 'here are a set of ideas as to how to do something differently'. A lot of students will have to make their own jobs in the future; there are entrepreneurial skills involved in this as well."

External partners usually have little or no money for research and development or creative thinking, so they are very keen to work with the University, which creates a space with freedom to experiment.

Lessons learned

This sort of course is somewhat radical. It can help to be under the radar to start with; if you can prove with a pilot that you have actually done something, and show the happy smiling students who have experienced a new course, that counts for a lot. Going with this kind of idea and trying to organise it all upfront is much more difficult.

Grand challenges can be a good way to frame such provision, as they are sufficiently broad to attract students and lecturers from all over the University, while also very relevant within a local area around the University.

Educational provision in the future should include some of this: helping students to take the deep knowledge they have developed and learn how to make it relevant and use it in the context of external projects alongside people with different knowledge and approaches to the world. For many people, that is what their jobs are like; we need to think how to prepare students for that, and to respect the knowledge of others.

Case study 3: New interdisciplinary undergraduate degree programme (BA and BSc)

Title/institution
Global Health and Social Medicine http://www.kcl.ac.uk/sspp/departments/sshm/study/Undergraduate.aspx King's College London (KCL)
Provision level, numbers, area
BA, BSc About 50 per year Health/Social dimensions
Nature of interdisciplinary provision
Three-year interdisciplinary undergraduate degree programme, offered as BA or BSc
Development
Global Health and Social Medicine is described in the KCL online prospectus as "a unique interdisciplinary programme designed for those who wish to understand the social determinants of health and illness in a social context, and to know and evaluate the range of medical and healthcare approaches that seek to tackle disease and alleviate inequalities in health." The two counterpart degree programmes under this title (the BSc began in autumn 2014; the BA will begin in autumn 2015) arise naturally from a department that is itself new (founded in 2012) and interdisciplinary. The Department of Social Science, Health and Medicine, with 18 of its 22 academics new appointments, represents a significant investment by the university. "You cannot do this kind of work unless a number of people in a department are invested in from the start. So, from the start, the ethos of the Department was interdisciplinary and the degree courses are the first that are interdisciplinary in this way in the UK. A key element is that they are pitched as genuinely interdisciplinary, with 75% in our interdisciplinary Department and 25% in other departments." The curriculum is thus research-led, with compulsory courses taught by the home Department's academics, and optional courses from the Department, other departments in the Faculty of Science and Public Policy, and the Faculty of Arts and Humanities, with an option each year from the Faculty of Life Sciences and Medicine (e.g. options within Ageing, Neuroscience or Pharmacology pathways). This element of the course, 25% of the whole year, is compulsory for those doing the BSc. A research-based dissertation forms part of the third year.
Challenges/opportunities
Challenges: Employers can work within their own traditions; so it is important to make them aware that interdisciplinary degrees produce nimble-minded professionals who can be useful to them in their own organisation. Parents of prospective undergraduates can be very conservative, so there can be work to do convincing them that an innovative interdisciplinary degree programme can be a pathway leading to meaningful work for their children. (This can be particularly challenging when pupils have already specialised very narrowly in school.) It is always hard work to make the whole thing cohere, when people come from different viewpoints; there may effectively be only eight weeks per term for students to get different

perspectives and understand that people approach things such as 'equity' differently.

Everyone wants you to do interdisciplinary education, but while you are trying, it can be very difficult. You have to liaise with different departments, and it comes down to nuts and bolts … With timetabling issues and so on, it becomes a very complex picture. To make it work, you need huge commitment behind the scenes … And you want lecturers in all departments to be welcoming to interdisciplinary students who are taking their modules.

Opportunities:

Students have the opportunity to "combine a rigorous Social Science education … with an introduction to key issues in Medicine." Graduates are expected to gain relevant high-level intellectual skills, knowledge and research techniques and to "think critically and independently about these issues", with a wide range of career options open to them related to health policies and health care systems (e.g. in public health, the health services, Government, NGOs, and commerce).

Recent recruitment indicates that this interdisciplinary Department has attracted very strong academics, which in turn has benefited interdisciplinary teaching. "Because we are all interdisciplinary scholars, we work collaboratively so we can teach material collaboratively."

"The students love us; they are passionate about the course and they love the degree; it is definitely the way forward, but one shouldn't underestimate the work it takes."

Lessons learned

Having people at the top, such as Deans and Vice-Principals, who are risk-takers and supportive is key. It would not happen without top-level support, but what goes on in middle management is really important – timetabling, room allocation or whatever – if they do not get on board, you can kill yourself running around. There can be stonewalling at all levels. You have to get all the middle management to come with you, which can be a challenge. There is a lot of legwork that has to be done to actually make that work.

Rather than sequential lecturers from different disciplines taking a more substantive line through the material, we try to do at least some of the synthesizing work for the students, while giving them an understanding of where different approaches come from. At the same time, we try to remain true to the classical roots of concepts from a field, rather than relegating them to an interdisciplinary talk that does not do them justice.

There is a huge ethos around interdisciplinarity and how it is valued; however, the whole way higher education is set up is based hugely on disciplinary foundations. It is very challenging to do interdisciplinary work unless there is a strong institutional commitment to providing all the appropriate forms of administrative support.

Case study 4: Professional education MSc – interdisciplinary development of careers in emerging technology

Title/institution
Design and Digital Media MSc http://www.ed.ac.uk/studying/postgraduate/degrees?id=37&cw_xml=details.php University of Edinburgh
Provision level, numbers
MSc course, approximately 50 students
Nature of interdisciplinary provision
MSc programme offering professional education in digital technology and design
Development
With career considerations a key driver, the professional education programme explicitly brings together multiple dimensions: "The MSc in Design and Digital Media is a unique programme of study that addresses the growing need for professional education in digital technology applied to design, including its social, cultural and philosophical implications … The programme addresses the needs of practitioners, managers, decision-makers and educators who want to be informed by first-hand knowledge of the technical possibilities of digital technology and an awareness of social, cultural and business contexts." "The students (mostly in mid-to-late twenties or older) are from different disciplines, including marketing, engineering and law, for example; they are people who have always had a passion in digital media but their professional trajectory gave them no scope for it, so they enrol in the programme. As they interact, they learn from each other." Appropriately, given its aims and approach, the programme is not narrowly prescriptive regarding prior work: "The subject disciplines (of the undergraduate degree) is not as important as attitude and commitment to study in this area." With a significantly international student body, this programme is now part of a suite of related courses at the University of Edinburgh, including a spinout MSc in Sound Design, an MSc by Research in Digital Media and an upcoming (autumn 2015) online course with a very similar title: MSc in Digital Media Design, the first online Masters degree to be offered by the Edinburgh College of Art, and one of sixty offered by the University. Some 12 years ago, interest in digital media was far less widespread in universities; yet for the minority of individuals who were interested in employing new technologies to stretch their work, digital studies and computing were "relatively straightforward in facilitating interdisciplinarity." As an example, architects were early adopters of "computer-aided design" – now 'digital media', which gave them common ground with those individuals in Engineering and the Fine Arts who were interested in Computer Science. A key figure in the development of the digital programmes was a move linking Music and Architecture at the University. "It was a combination of luck, proximity of departments, organisational structures facilitating interaction and the computing thing." (A jointly supervised PhD student in music, who was interested in space, tutored in the Design and Digital Media programme and went on to do much of the design of the spinoff MSc course in Sound Design.) The MSc programme "develops wide skills in digital techniques and a critical framework to appraise the application of these technologies to design" – while "based in a lively studio environment." Teaching includes seminars, lectures and tutorials as well as practical sessions and studios. In particular, projects "bring out original thinking and independent achievement within a framework of team-working and creative ability"; one of several stated learning outcomes is that students will "develop their ability to work cooperatively in groups in the context of design."

Challenges/opportunities

Challenges:

When working across large schools, it is very difficult to organise a joint programme across them, as it would be impeded by structures. (It is easier to have interactions when collaborating within the same financial unit.)

Opportunities:

Regarding interdisciplinarity at the Masters level, for many students it is a second chance – giving themselves the opportunity to diversify or move into an area where they have passion or that will be a stepping stone in their career.

Lessons learned

- interdisciplinary provision has to be genuine. It has to be driven by some sense that there is something important to achieve. It is no good just throwing together pairs or triplets of disciplines without a rationale. Do not just start with a discipline and say "How can it interact with another particular discipline? We really should do more together." It can be done this way, but it will not achieve much – it has to be driven by a purpose or objective;
- it is about recognition and acknowledgement of difference and incommensurability, and somehow coping with that. You never get away from the inevitable tensions between disciplines. Universities are places of disagreement as well as agreement; it is how you deal with it that matters. Do not necessarily look for common ground all the time, or feel you all have to agree all the time, but aim for an openness across many dimensions. Any team needs to acknowledge that there will be lots of differences across many disciplines;
- one extreme of a joint degree would be leaving everything in terms of integration to the students with lecturers never seen talking with each other; the other extreme would be where the curriculum is entirely integrated. Halfway is simply showing solidarity with other disciplines, even sometimes having two lecturers in the same room – talking and being engaged. Students can see that it is worth doing and that other people are committed to integration and interaction. That ought to be the minimum – where lecturers from different disciplines are not in dispute or ignoring each other or sending students off on their own to deal with the process of synthesis, but are engaged and setting an example;
- structures often bring people together and it is usually the enthusiasm of individuals that drives interdisciplinarity. It does not usually work when it is top down. It is more compelling and has more momentum when developed by a couple of enthusiastic staff members who build from the ground up.
- it is crucial to have group work; it can be challenging to work with people from other disciplines. Different disciplinary backgrounds can influence individuals' willingness to work with others who have different approaches;
- even at the undergraduate level, as students use online media and resources, a wealth of insights from other disciplines are appearing in essays and dissertations. "We have to know more about other disciplines, similarities and differences, different ways of framing and looking at knowledges; otherwise we will not survive in the online digital age. Students need to develop skills; it is inevitable that they will although lecturers may show resistance; students in their future work will have to work in that way, aware of different bodies of expertise."

Case study 5: An undergraduate degree bridging Arts and Sciences with a major, a minor, and interdisciplinary core modules

Title/institution
Arts and Sciences (BASc) degree www.ucl.ac.uk/basc/prospective University College London (UCL)
Provision level, numbers
BASc, intake of 120 students a year
Nature of interdisciplinary provision
Undergraduate degree programme (BASc): three years or, with optional study abroad, four years.
Development
At UCL, the Arts and Sciences (BASc degree) requires that students develop two academic specialisms, or 'Pathways', one in Arts (or Social Sciences) and one in Sciences. With a major in either the Cultures Pathway or Societies Pathway, a student would take a minor in the Health and Environment Pathway or Sciences and Engineering Pathway (or vice versa). During their first year, students pick three modules from among the 8-12 modules offered in their major Pathway; in later years they can select from any appropriate modules offered by the University. In addition, Core courses are given "to enhance understanding of how different branches of knowledge interrelate", providing "the skills and concepts (the student) will need to work effectively across multiple disciplines" and encouraging new linkages across traditional subjects and/or exploration of differences between Arts (or Social Sciences) and Sciences. (Of the 12 units comprising the degree, approximately six are in the core courses and the remaining half in pathways – 4.5 in the major pathway and 1.5 in the minor pathway.) Extending the bridging theme of the degree, students may take a four-year version that includes studying abroad in another country. A foreign language is required as part of the core and is taken each year. A summer internship is offered with full support from a dedicated careers specialist before the last year. Core courses/modules are described on the website as falling in two groups: 1. techniques useful in making interdisciplinary links across all studies (e.g. Quantitative Methods: Exploring Complexity; Interdisciplinary Methods); 2. interdisciplinary/multidisciplinary approaches (e.g. Approaches to Knowledge, Qualitative Methods, Object-based learning). In their last year, all students write an interdisciplinary capstone dissertation as well as taking a compulsory core module on the Knowledge Economy. In this module, students work in small teams as consultants to produce a report for a local business, sourced by UCL's Centre for Entrepreneurship, UCL Advances. The BASc Programme FAQ makes two distinctions between the programme and "many Liberal Arts programmes", in that the BASc programme has an Interdisciplinary core of subjects that students take and that students must take both Arts and Science subjects all the way through their studies. Similarities to liberal arts programmes include the flexibility and diversity of what can be studied, as well as the major/minor structure that is often seen in liberal arts programmes. BASc students at UCL form a 'community', with their own department and common room; especially in first year when they take three core courses together, they bond with each other in core courses that are openly interdisciplinary in approach. They study with other BASc students as well as 'traditional' discipline-based students in pathway modules. Importantly, they "have fantastic

students who are up for this and want to make it work."

The initial conceptualisation of this degree programme was led from the very top of the University, the then Provost and Vice Provost Education, who "saw the rise of the Knowledge Economy and increasing globalisation, and saw that keeping very restrictive practices in the curriculum would be counterproductive and wouldn't serve students who were going out into the world." Discussions began six years ago, with the current programme director acting somewhat as an entrepreneur for the last five years, working initially with a 32-person steering group and now a small full-time team of four others, and talking with hundreds of colleagues to develop the programme. Now, with 120 new students each year, the degree is established and the programme has one of the University's bigger intakes. This has ramifications across the University. For example, the students take over 300 modules between them, involving multiple departments and registry offices. With "brilliant colleagues", "even if there are bumps, you can have good conversations and work through them."

Broadly, the degree produces two types of graduates: high specialised interdisciplinary graduates, and those who prefer to be called 'generalists'. Of the former type, examples include specialists in global child mental health, development economists with an expertise in engineering, those looking at the sociology and anthropology of ethnic art, and experts in the legal aspects of urbanisation. Such students become specialists by looking at a particular object of study through different disciplinary lenses. Among the generalists, students may take a very wide range of courses in, for example, Chemistry, Management Accounting, and Arabic. Such students are aware that many graduate jobs would benefit "from the widest range of skills possible" and are therefore using this degree to try to garner such skills. At the time of writing, students have secured jobs in finance, consultancy, NGOs, Law, marketing, etc. and others are progressing to Masters in Evolution, Palaeontology, Energy Systems, International Security, Business, Law and English Literature.

Challenges/opportunities

Challenges:

It is quite a brave step to cross between Arts and Sciences; most programmes shy away from including lots of Science.

Opportunities:

"The principal thing that unites the students is that they are all interested in lots of different things. There is a liveliness, openness and creativity that you may not find everywhere; it is special."

Lessons learned

- you can make extraordinary things happen if you believe in something and keep working on it. Believing, working and not shirking but dealing honestly with difficulties – can make things happen!
- clever students did things I thought were not possible! Once a handful succeed, many of your anxieties melt away and all these wonderful and meaningful combinations do open up and you realise the curriculum has that potential;
- we need to inspire the next generation and help them believe the world has changed and inspire them to love this era of learning, when the possibility of learning is greater than ever. We need to show them by our actions that learning is the main thing. It starts with learning, if you love learning and keep learning, great things will happen – you will either become a great researcher or some company will snatch you up. We do need more interdisciplinary learning; it is so productive; it fosters love of learning, openness to ideas and a creative approach to one's learning in life;
- universities could influence business and Government with some of our values, about exploration and valuing intellectual life. Many businesses are becoming like the best postgraduate courses, with people buzzing around, and a playfulness. Universities have the potential to have a deep cultural effect on the rest of the world.

Case study 6: Top-level, institutionalised support for interdisciplinary undergraduate education at a major US university

Title/institution
Bass Connections programme Duke University, North Carolina, US https://bassconnections.duke.edu/
Provision level, numbers
Undergraduate
Nature of interdisciplinary provision
Range of innovative interdisciplinary undergraduate modules, often involving team projects and/or experiential learning
Development
Ranked 18 in Times Higher Education World Rankings 2014-15, Duke University has made a substantive commitment to interdisciplinarity. There has been a Vice-Provost for Interdisciplinary Studies within the Provost's Office for 16 years, with an office created to implement aspects of the University's 2006 Strategic Plan, when interdisciplinarity was identified as a key dimension for the University: the "stake was put in the ground and it really focused where we would put energy and resources." "We found that, compared to other places, we are really doing interdisciplinarity. We put resources toward it; we changed policies and structures to facilitate it, bringing about both structural and cultural change." Although Duke University has a traditional structure of departments and disciplines, it does have a "history of flexibility"; furthermore, the office is working between and among the structures to achieve further interdisciplinarity. Rather than simply adding interdisciplinarity as another responsibility for a Research Office, establishment of a designated Vice Provost and an Office for Interdisciplinary Studies made it possible to pursue a broader role, in both research and education. While Duke had set up some seven interdisciplinary institutes in complex areas such as global health, ethics, brain sciences and so on, these were initially more focused in the realm of research. A dozen faculty leaders, some Deans and a generous donor shared a vision for an educational innovation that seemed to be the right thing to do, at the right time, in the right place: the innovative Bass Connections programme was established as a focus for interdisciplinary education, linking undergraduate and graduate instruction and inquiry. After significant planning, the programme officially began activities in the autumn of 2013. In addition to the Vice Provost, senior level staff in the Office contributing to the programme include a Director for Administration and Program Development and an Assistant Director for Communications and Administration; there is a 14-member Faculty Advisory Council and also a Student Advisory Council with representatives from across student levels and themes. Both Advisory Councils make recommendations on the development of the Bass Connections programme and also champion the programme. Although Duke may be further along than many peer universities in the US, this "developmental pattern" has been observed in other institutions: "There seems to be a progression in setting up infrastructure for interdisciplinary research and education; it seems to be that most places invest in interdisciplinary research, planting a seed to get as much interdisciplinarity going as possible … and we've seen interdisciplinary undergraduate education come later in institutional development." A "university-wide initiative that links faculty and students to respond to complex challenges through problem-focused educational pathways and project teams", the Bass Connections programme supports "problem-focused educational pathways" and "interdisciplinary project teams". As described on the programme website, its vision is "to create a distinctive new model for

education, exploring societal and cultural challenges through collaborative, problem-centered learning." Objectives call for innovation on several levels:

1. "Students gain problem-centered expertise and team-oriented skills and then use them to apply knowledge, research, and skills across disciplines to explore societal and cultural challenges.
2. Faculty members integrated education, research, and outreach as well as disciplinary approaches to explore societal and cultural challenges within specific themes.
3. Duke administration, departments, schools and institutes make infrastructure and programmatic changes that facilitate and sustain above objectives."

The initial themes that underpin supported activities are related to strategic research emphases, and include: Brain and Society; Information, Society and Culture; Global Health; Energy; Education and Human Development. Some 55 project teams have been supported this past year. In some cases, for example, classes are team-taught on a topic from different disciplines; or an academic might broaden his or her own focus by bringing in other experts; or course structures might be changed to incorporate more experiences as a different style of learning. Often, changes lie in taking some educational element that already exists and adjusting it to have a more interdisciplinary, applied and/or collaborative focus. Very often, students gain experiential learning within an interdisciplinary setting. The Office for Interdisciplinary Studies can help facilitate interdisciplinarity through roles like provision of seed funding, assistance with institutional change, and providing a resource centre and sharing good practice, for example, through its Team Resource Center.

Challenges/opportunities

Challenges:

Academic time and curriculum credit can be issues.

Opportunities:

The premise of the Bass Connections programme is that interdisciplinarity should not come at the expense of the disciplines, as disciplines remain important. Nonetheless, the programme's 'History' web page poses the following question and goal:

> how can we fully embed this powerful form of understanding in the educational experience of our students, and how can we expose students to a multi-faceted understanding of the complex challenges of our time? … The goal of Bass Connections is to achieve genuine interdisciplinary education, which provides a careful balance between the depth of knowledge needed to understand a problem from one discipline and the breadth across several disciplines needed to understand that problem in all its complexity. (See: https://bassconnections.duke.edu/content/history)

Lessons learned

- have a person in the vice provost role whose job it is to wake up every day and think how to advance interdisciplinarity in the institution;
- focus on places where there is some existing interest – student interest and faculty interest;
- this takes time and is really complicated! People sometimes get impatient with the pace of it, but it can take two to three times to work through something (like a new course); the process is important. Getting people in the same room, having them spend time together and figure out what they are doing – that has to happen! Some people complain that there are so many meetings and conversations that development lasts so long – but that is what it takes.

6. Principles for the development of interdisciplinary education: conclusions of our study

The word 'interdisciplinary' denotes a spectrum of experience and our findings support the HEA's statement in its call for tenders[29] that "there are a range of approaches to introducing interdisciplinary provision in to the curriculum." This is to be expected given that interdisciplinarity is not, itself, a cohesive subject, approach, or methodology, but a term that can be misunderstood and misappropriated.

While compulsory interdisciplinary courses may have become a standard feature of the curriculum at many US colleges and universities (Goodman and Huckfeldt 2013), the same is not yet true in the UK.[30] Variation in interdisciplinary provision is therefore unsurprising given the relatively early stage of its evolution within UK higher education.[31] Our findings do, however, indicate that interdisciplinary learning and teaching is already an explicit component of many institutional strategies. Across all of our respondents, most feel that the level of interdisciplinary educational provision has increased at their institution over the past five years. Looking to the future, most respondents expect this level to increase further. There are, nevertheless, differences in the views expressed by classes of respondents (see Section 4) indicating variation in understanding of the drivers and motivators for interdisciplinary learning and teaching.

Our study has sought, in part, to categorise the types of interdisciplinary provision currently available in the UK. Curriculum enhancement ambitions are becoming more widespread in the UK with many universities seeking to combine academic excellence with a greater focus on, *inter alia*, skills such as critical thinking and effective communication, engendering openness to more reflexive learning and personal development, and preparing students for global citizenship. However, curriculum enhancement and a more integrated approach to learning do not necessarily constitute 'interdisciplinarity' and the pedagogical approaches included in some descriptions of 'interdisciplinary provision' are not unique to interdisciplinarity.

'Integrative learning' is often used as an umbrella term for activities that bridge, for example, experiences inside and outside the classroom, theory and practice, and disciplines and fields, while interdisciplinary studies is a subset of integrative learning "that fosters connections among disciplines and interdisciplinary fields" (Klein 2005, p. 8).

According to Klein (2005), the intersection of integration and interdisciplinarity hinges on a crucial distinction: multidisciplinary approaches align subjects or disciplines in parallel schedules or units, but not modified in any way, where teachers present their perspectives separately. In this model, students gain that fosters connections among disciplines and interdisciplinary fields breadth of knowledge but explicit analysis of disciplinary perspectives and synthesis across disciplines is usually missing. In contrast, Klein argues, interdisciplinary models restructure the curriculum with explicitly integrative activities that are typically theme-based, problem-based, or question-based and organised within a curriculum that has a spine of required core courses ensuring attention is paid to interdisciplinary theory, concepts and methods. There will be a spectrum of interdisciplinary experience from a weak model of interdisciplinarity (generally manifested by a series of linked courses that focus on a theme) contrasted with a strong programme with full-time faculty appointments, anchored in good practice,

[29] www.heacademy.ac.uk/funding-call/interdisciplinary-provision-higher-education-current-context-and-future-challenges [Accessed 15 June 2015].

[30] The Higher Education Statistics Agency (HESA) does not, for example, produce any data on interdisciplinary degrees.

[31] It is worth noting that the Scottish curriculum (at both secondary and tertiary level) has traditionally allowed for a greater breadth of subjects to be studied than the English system and this may result in even greater variation.

with an understanding of interdisciplinarity communicated to all parties in order to develop a culture based on integrative values and portfolio-based assessment (Klein 2010a, pp.106–7).

Done well, this should develop within students the ability to:

- ask meaningful questions about complex issues and problems;
- locate multiple sources of knowledge, information, and perspectives;
- compare and contrast them to reveal patterns and connections;
- create an integrative framework and a more holistic understanding;
- adapt knowledge in unexpected and changing contexts. (Klein 2005)

such that, "as workers, parents, and citizens" they will be able to apply knowledge and solve problems that are not "in the book" (Klein 2005).

Current research at the University of Copenhagen on how different actors (students, teachers and administrators) are creating or hindering interdisciplinarity also identifies many different models of learning and teaching, but finds that, too often, such courses are simply 'pluridisciplinary'.[32] Lindvig cautions that simply presenting two disciplines to the students is not interdisciplinarity, and relying on students to be the sole agents of integration is not a dependable strategy.[33]

What we discern through our own empirical data and case studies are a range of activities taking place at different scales – at the level of one-off workshops, single course modules or units, or sometimes full degree programmes. These activities have different (and not always fully articulated) aims: whether they manifest in a general awareness of knowledge beyond the student's immediate degree discipline, an ability to go further and apply that knowledge, or a more root-and-branch transformation of the student's way of thinking and viewing the world. In this last situation, interdisciplinarity might be viewed as a 'threshold concept' (e.g. Meyer and Land 2005) where students are not only taken into a space where they see things differently but may, as a result, become different kinds of learners.

From the literature (Section 3), we have identified a set of pedagogical techniques (Table 3.1) that are discussed within the context of effective practice in interdisciplinary learning and teaching and a recognition that "'interdisciplinary teaching and learning requires a host of powerful pedagogies" (DeZure 2010, p. 384). However, commentators also stress that "There is no unique or single pedagogy for integrative interdisciplinary learning" (Klein 2005) and that "Interdisciplinary pedagogy … is not synonymous with a single process, set of skills, method or technique" (Haynes 2002, p. xvi; quoted in DeZure 2010).

What is largely missing from this literature, and from the empirical data we have collected, is a debate about, or evidence for, the underlying "curriculum ideologies" (Toohey 1999, p. 45) – the principles, ideas, beliefs and epistemologies that might underpin interdisciplinary learning and teaching. Once again, this suggests that theory has not yet caught up with practice in this field: one could easily still argue that interdisciplinary study remains "the most seriously underthought critical, pedagogical and institutional concept in the modern academy" (Ellis 2009, p. 3 quoting Liu 1989). The gap that we identify in the existing literature is not so much about the types of disciplines that are not currently being included (as implied in HEA's research questions), but about the lack of theorising about pedagogy in this emerging area of learning and teaching practice.[34]

Our survey data suggest that the prevailing orthodoxy among university leaders supports the concept of tertiary education as preparation for employment (Toohey 1999, p. 45). However, while the Quality

[32] Personal communication, Katrine Lindvig, University of Copenhagen, 12 June 2015.
[33] Yet, our empirical findings suggest that very often this responsibility *is* placed upon students, contrary to the advice offered in much of the literature we have reviewed about clarity of course goals and outcomes for the students and the recognition that simply expecting students to make sense of interdisciplinarity on their own will be too challenging for the majority.
[34] In this respect, the field of interdisciplinary learning and teaching has not progressed a great deal since Thew's earlier study for HEA (Thew 2007).

Assurance Agency for Higher Education's (QAA's) review activity and enhancement themes may have raised university leaders' awareness of employability, our enquiries[35] regarding employer views on interdisciplinarity found that, while there is much that relates to what employers value in undergraduates and, to some extent, postgraduates, there is nothing on interdisciplinarity *per se*. Nor does the employability issue surface as a driver in any of the academic literature on interdisciplinary learning and teaching that we have found.

Although the most obvious drivers for increasing interdisciplinarity may be instrumental (e.g. perceived new income streams, improved graduate employability), the issue of interdisciplinary provision points to the heart of how universities are organised and the purpose of higher education. They exemplify the ongoing process of change within disciplines, which are themselves a relatively modern phenomenon. Our approach was to look for new and emerging examples of interdisciplinarity within five fields,[36] but what might we have learned from inherently interdisciplinary subject areas that are long-established but do not necessarily espouse that label, such as Education, Medicine, Geography or Psychology? The cycle of evolution, as new disciplines emerge (e.g. Digital Humanities) and become concretised (e.g. Science and Technology Studies), must inevitably have some impact, not just on research in these areas but also on learning and teaching. A key unanswered question is whether interdisciplinarity is evolving within universities or whether universities are, themselves, evolving.

Our findings mirror those of our colleagues at the University of Copenhagen in highlighting the often passionate commitment of an entrepreneurial academic as a key driver. Very often these academic pioneers aspire to a new, holistic intellectual growth among their students. Sometimes this aim is aligned with an emerging field that poses a set of questions or problems demanding interdisciplinary inquiry in both research and teaching. Often, this is an activity that is happening at the margins of mainstream teaching. This is a risky strategy for the sustainability of interdisciplinary learning and teaching: if it is not to rely solely on the efforts of individual champions, greater institutionalisation will be necessary but this takes us back to Klein (2010a, p. 123), quoted in the introduction, on the tension between "normalisation" (in order to gain strength and stability for such programmes) and the "mission for insurgency" inherent in interdisciplinarity.

Despite the existence of such interdisciplinary converts, Toohey's assertion (1999, p. 47), that teachers are still wedded to the idea of "coverage" such that "although many departments pay lip service to a range of different educational goals, the discipline approach which promotes breadth [in terms of covering the full discipline] rather than depth is still the dominant model" remains largely true. Despite the trends that we have identified, the tendency to isolate knowledge and different ways of knowing and the emphasis on "mastering individual elements such as a discipline or methodology rather than on integration" (Toohey 1999, p. 47) prevail.

The recent Higher Education Policy Institute (HEPI)/HEA Student Academic Experience Survey results,[37] which indicate that students prioritise the need for their lecturers to have formal training in teaching rather than being involved in current relevant research, may be a further driver for change if they intensify pressure on staff to gain formal teaching accreditation (Grove 2015). This may, in turn, engender a culture change that counters a degree of cynicism about formal training evident in some parts of the sector (Hibbert and Semler 2015) and the tendency to undervalue teaching, particularly within research-intensive universities.

[35] Personal communication, Shelagh Green, Head of Careers Advisory Service, University of Edinburgh.
[36] Sustainability; International Development; Health (social dimensions); Games (digital); Culture.
[37] www.hepi.ac.uk/wp-content/uploads/2015/06/AS-PRINTED-HEA_HEPI_report_print4.pdf [Accessed 14 June 2015]

6.1. Recommendations regarding HEA's role in supporting interdisciplinary learning and teaching

We conclude that a successful interdisciplinary curriculum should be aimed at mitigating the institutional and personal challenges of interdisciplinarity on the one hand, and fulfilling specific learning objectives expected from interdisciplinary education on the other. We therefore identify three potential roles for HEA in supporting interdisciplinary learning and teaching.

In the face of likely trends toward at least some degree of increase in interdisciplinary provision, both the PVCs and programme directors whom we surveyed agreed that access to a body of good practice in interdisciplinary provision would be appreciated. Survey responses also indicate that this desire contrasts sharply with current reality. Suggestions from our respondents on the types of support that might help them to be more effective in interdisciplinary teaching did underscore the importance of institutionalised support, for example, in university strategies, through institutional reforms or the inclusion of interdisciplinarity in PGCHE provision. Access to research and good practice (e.g. in the form of case studies) was emphasised, as were skills development training, for example through organisation of masterclasses, or through funding for trials and test projects.

First, a significant role for HEA in supporting subscribing institutions may be to act as a respected forum where experiences of interdisciplinary learning and teaching can be developed and shared. Our study identified at least two self-organising networks formed by programme directors to discuss issues and share good practice. We have previously used the masterclass approach to build interdisciplinary research capacity at different career levels (Lyall and Meagher 2012). Such masterclasses can draw upon actual practice and encourage reflection on key processes. This approach could support academics already involved in, or beginning to develop, sound interdisciplinary provision. There could be a role for HEA in supporting accessible external masterclasses to supplement academic development offerings available within institutions.

Secondly, in addition to this developmental support, HEA may wish to take the lead as a locus for defining a pedagogic research agenda for interdisciplinarity to underpin this important learning and teaching activity with the necessary theoretical understanding, which we currently find to be lacking. This could help the sector to navigate the differences in epistemologies of different disciplines, which pose a particular challenge in team teaching, and can be especially problematic given the heterogeneity that we have encountered (e.g. preparing students for the modern workplace, meeting the requirements of professional training, or laying the groundwork for postgraduate research).

Finally, HEA plays an important leadership role in the higher education sector. In supporting interdisciplinarity in undergraduate and postgraduate taught education, HEA may wish to encourage leaders of HEIs themselves to reflect upon the following underlying principles of interdisciplinary education:

1. If institutions are going to embark on a strategy of interdisciplinary learning and teaching, there must be clarity of purpose:
    a. institutions should recognise that, with no one all-purpose pedagogy for interdisciplinarity, they must articulate clearly their own goals and develop strategy accordingly;
    b. the potential for interdisciplinary education to add value to an institution and its outputs should be articulated clearly: to staff but also to students, parents, employers and other stakeholders;
    c. curriculum enhancement, integrative learning, and interdisciplinary learning and teaching represent different goals and require staff and students to develop different sets of well-aligned competences in learning and teaching.
2. If institutions are to develop effective interdisciplinary learning and teaching, this requires a whole institution approach in order to overcome the many academic and administrative barriers that exist:

a. some of these barriers may be perceived rather than real but it will require a concerted process of institutional change to overcome both the misperceptions and the realities;
b. not all institutions, nor indeed every part of each individual institution, will embrace interdisciplinarity; this is reasonable in a healthily diverse higher education system. However, for those institutions seeking excellence in interdisciplinary education, advocacy, facilitation, celebration and reward will be key;
c. in promotion and other professional assessments, recognition must be clearly available for interdisciplinary activity relevant to education (e.g. teaching, mentoring, and development of new courses and related research).

3. Successful interdisciplinary learning and teaching is resource intensive:
    a. the development of a coherent interdisciplinary course takes time, if it is not to rely on students to do the integration: this needs to be recognised, for example, in models of workload allocation;
    b. for some universities this will require considerable culture change if staff are to be adequately trained, supported and rewarded. Skills development should be facilitated in academics taking on the challenge of effective interdisciplinary teaching. This training might take various forms, whether in-house or external short courses or expert masterclasses;
    c. various other forms of support may be required, ranging from institutional advocacy to seed corn funding for course development, to administrative matters such as scheduling and credit-sharing across departments. Pioneering academics should be facilitated to share their own learning about good practices within their own institutions and across the sector.

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Annexes

A. Interview topic guide

B. Agenda for Advisory Group meeting, June 2015

C. Focus group topic guide

D. Literature review method

E. Full set of survey charts

F. Lessons learned

G. Survey instruments

A. Interview topic guides

Semi-structured interview template, course co-ordinators/ programme directors

I. BACKGROUND

- Please describe your programme briefly. (Topic, key themes; target/degree level, approximate number of academics and of students, age of programme.)
- Were you involved directly in the launch? Subsequent evolution? What is your role now?
- How would you describe the process of the development of the course/programme?

II. NATURE OF PROVISION

- What was the primary motivation for establishing the programme? Other drivers?
- What is 'special' about the programme? What value does interdisciplinarity add? Is interdisciplinarity central to the programme or a bonus?
- What disciplines/fields/units are bridged – and why were these included? Were others hoped for, but not included?
- Would you say that the academic staff keep to their own fields in their own modules, or are they actively involved in design and implementation of synthesis or emergent integration across the course/programme? Has engagement of individual staff members changed over time?
- Are there particular components of the course/programme (e.g. seminars, assignments, projects) that propel interdisciplinarity effectively?
- Who is responsible for interdisciplinary learning? Student? All staff? Programme director?
- What are the features of your programme that you are proudest of?

III. PRACTICE/PEDAGOGY

- Have you found/developed any key pedagogical methods for interdisciplinary education?
- Have you ever received (or provided) training or staff development in interdisciplinary education/teaching? Would you like to? In what format?
- What supportive role might the Higher Education Academy (or others) play?

IV. CHALLENGES/ISSUES

- Have you encountered challenges in providing interdisciplinary education? What are they? How have you addressed them?

V. OPPORTUNITIES/ADVANTAGES

- What positives/opportunities/advantages have you found particularly meaningful when providing interdisciplinary education?

VI. LESSONS LEARNED

- What lessons would you share with others, about either dealing with challenges or making the most of opportunities?
- Would you like to offer any advice on:
  - pragmatically dealing with university structures/politics/administration?
  - good practice in pedagogy?
  - principles for frameworks underpinning high-quality interdisciplinary provision?

VII. BIG PICTURE

- Does your institution support interdisciplinary provision? If so, how? If not, why not?
- Do you see interdisciplinary provision as likely to increase or decrease at your institution? Generally? Why?
- Is there any 'big picture' message you would like to send to the Higher Education Academy, or HE policymakers, about interdisciplinary provision?

Semi-structured interview template, PVCs, VPs, Deans

I. BACKGROUND

- What would you say are the highlights of interdisciplinary educational provision at your institution? ((Topic, key themes. Target/degree level, approximate number of academics and of students, age of course.) About how many interdisciplinary programmes exist? Are there also separate interdisciplinary modules?
- How would you characterise your institution's culture relative to interdisciplinarity? For instance, is interdisciplinary research talked about more often than interdisciplinary teaching? Is either highlighted explicitly in institutional strategies?

II. NATURE OF PROVISION

- What have been the primary drivers for establishment of interdisciplinary educational provision?
- What is 'special' about the programme(s)? What value does interdisciplinarity add? Is interdisciplinarity central to the course/programme or a bonus?
- What breadth of fields/units are bridged (e.g. Humanities + Social Science + Natural Science, or natural Science + Natural Science)?
- Would you say that the academic staff tend to keep to their own fields in their own modules, or are they actively involved in design and implementation of synthesis or emergent integration across the course/programme?

III. TRENDS

- Do you have the sense that interest in designing and delivering interdisciplinary provision has increased or decreased over the last few years? At your institution? Generally, in academia?
- What do you see happening in the next five years? (undergraduate, postgraduate) Why?

III. PRACTICE/PEDAGOGY

- Does your institution provide training or staff development explicitly in interdisciplinary education/teaching? Would you like your office/academic staff to have increased access to a body of good practice in interdisciplinary provision? (If so, in what format?)
- What supportive role might the Higher Education Academy (or others) play?
- What do you see as key pedagogical methods for interdisciplinary education?

IV. CHALLENGES/ISSUES

- What would you say is the most serious challenge or issue facing interdisciplinary education? (Have you addressed it at your institution? How?)

V. OPPORTUNITIES/ADVANTAGES

- What do you see as the most exciting or meaningful positive/opportunity/advantage related to interdisciplinary education?

VI. LESSONS LEARNED

- What lessons would you share with others, about either dealing with challenges or making the most of opportunities? For instance, would you like to offer any advice on: pragmatically dealing with university structures/politics/administration? Good practice in pedagogy? Principles for frameworks underpinning high-quality interdisciplinary provision?

VII. BIG PICTURE

- Is there any 'big picture' message you would like to send to the Higher Education Academy, or HE policymakers, about interdisciplinary provision?

B. Agenda for Advisory Group meeting, June 2015

Date: Friday 12 June 2015

Venue: STIS Seminar Room, University of Edinburgh, Old Surgeons' Hall, High School Yards, Edinburgh EH1 1LZ Link to map

Travel: Off peak Leuchars trains arrive Waverley 10.55 and depart 16.28

Participants:

Project team: Catherine Lyall, Laura Meagher, Ann Kettle, Justyna Bandola

Advisers: Sian Bayne (arriving around 12.00), Paul Hibbert, Jens Dolin and Katrine Lindvig (by Skype 12.00-13.00)

Apologies: Morven Shearer

Agenda:

11.15	Coffee and introductions
11.20	Introduction to the project (Catherine Lyall)
11.30	Overview of key findings from literature review (Justyna Bandola)
11.45	Highlights from survey results (Laura Meagher)
12.00	Skype discussion with Copenhagen team
13.00	Sandwich lunch
13.30	Focus Group on forms of interdisciplinary provision and effective practice (facilitated by Laura Meagher)
15.00	Tea
15.15	Focusing on typologies, pedagogies and principles for our final report (facilitated by Catherine Lyall)
16.00	Close

C. Focus group topic guide

Forms of interdisciplinary provision and effective practice

Interdisciplinary provision

Why?

- Drivers?
- IS there a market? Why or why not? For which forms of provision?

What?

- Do some forms of provision 'matter' more than others?
- Can some forms of provision lead into other forms?

When?

- Trends? Is there/will there be a 'wave'?
- Are some of the forms of provision likely to increase more than others?

Who?

- Role of individual champion/entrepreneur versus institutional strategy?
- Engagement of colleagues?
- Who commits what resources?

Development and sharing of good practice

How?

- What is good practice? What seem to be key features of good practice?
- How do we know what good practice is? Criteria - at level of class, module, degree programme, institutional efforts?
- Self-evaluation, reflection, formative evaluation within a programme? Institution-wide analysis? 'Official' evaluations?

Where?

- Where (how) is good practice best shared?
  - Internal institutional staff development efforts? (Housed in HR? Academic development units?)
  - External short courses/masterclasses?
  - Conferences/workshops?
  - Clubs?
  - Articles? Where?

D. Literature review method

Table D.3: Main higher education journals publishing articles on interdisciplinarity which were searched during literature review
Journal title
Active Learning in Higher Education
Assessment and Evaluation in Higher Education
College Teaching
Higher Education
Higher Education Research and Development
Innovative Higher Education
Journal of Curriculum Studies
Journal of Higher Education
Review of Higher Education
Studies in Higher Education
Teaching in Higher Education

Table D.3: Quantitative results of literature search	
Search phrase	Results
Interdisciplinary teaching	• Academic journals (31,773) • Magazines (3,517) • Reports (2,814) • Books (353) • Reviews (275)
Interdisciplinary learning	• Academic journals (38,337) • Reports (2,780) • Magazines (2,097) • Books (225) • Electronic resources (187)
Interdisciplinary education	• Academic journals (83,554) • Magazines (7,642) • Reports (5,969) • Reviews (662) • Books (614)
Interdisciplinary curriculum	• Academic journals (17,206) • Reports (3,357) • Magazines (2,320) • Books (197) • Trade publications (119)

E. Full set of survey charts

Chart 1: Interdisciplinary 'span' as seen by programme directors

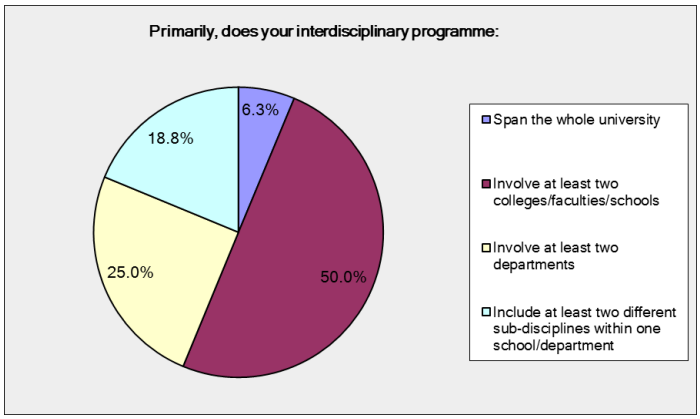
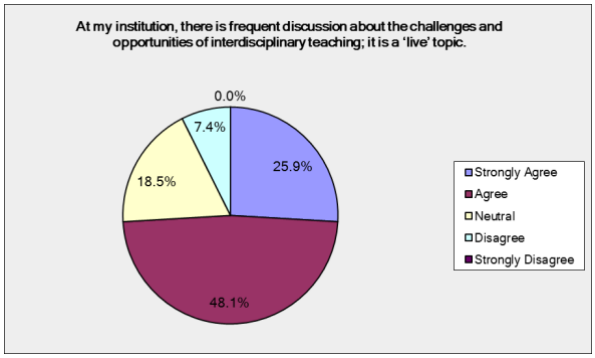


Chart 2: Perception of interdisciplinary educational provision as a 'live' topic as seen by:

(a) PVCs



(b) programme directors

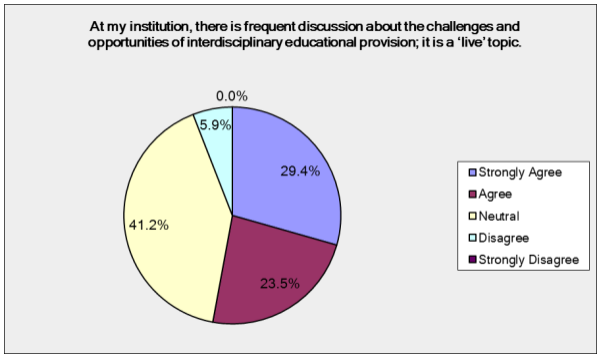


Chart 3: Number of interdisciplinary undergraduate programmes, estimated by PVCs

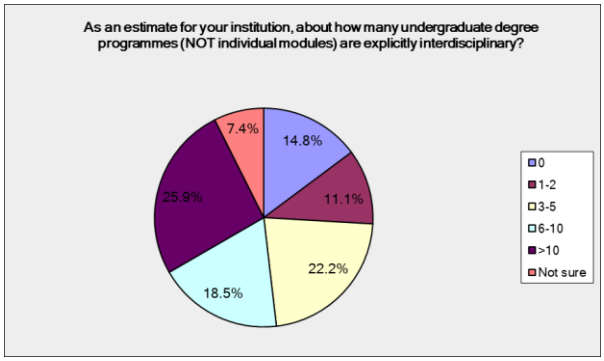


Chart 4: Number of interdisciplinary taught postgraduate programmes, estimated by PVCs

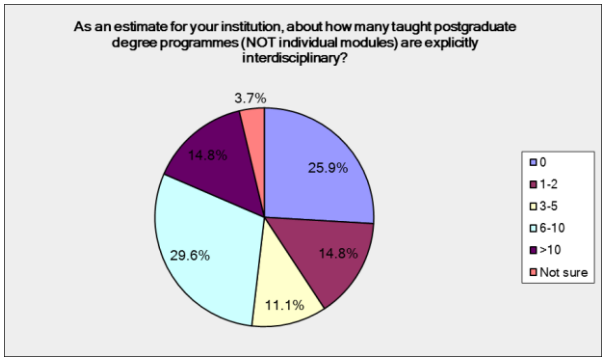


Chart 5: Drivers leading to interdisciplinary programme, as seen by PVCs

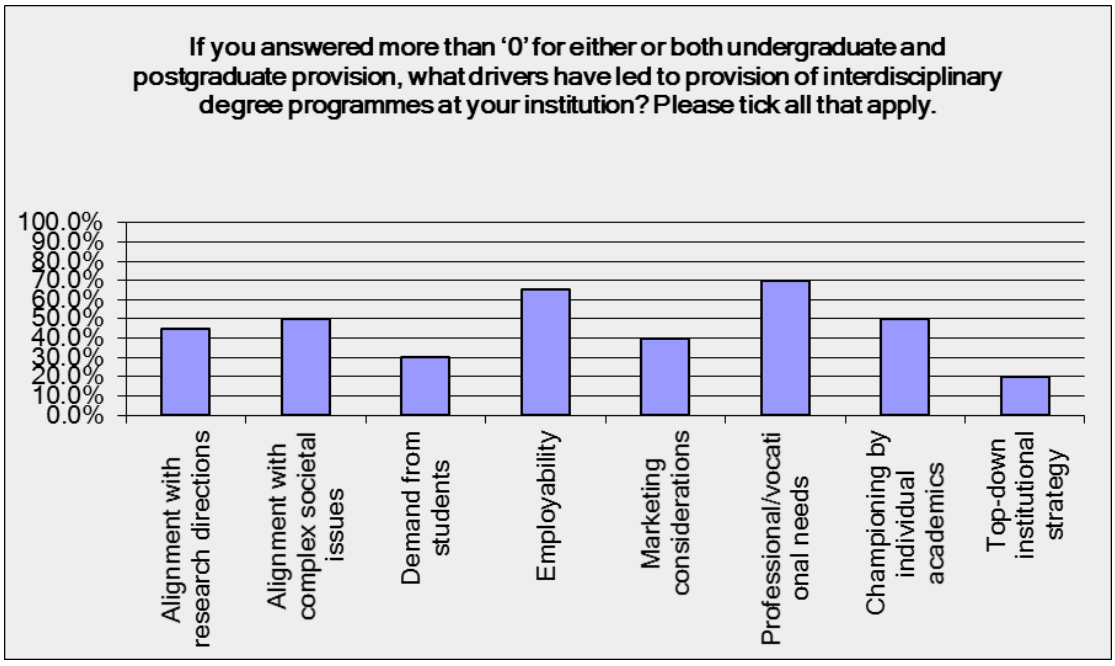


Chart 6: Drivers leading to interdisciplinary programme, as seen by programme directors

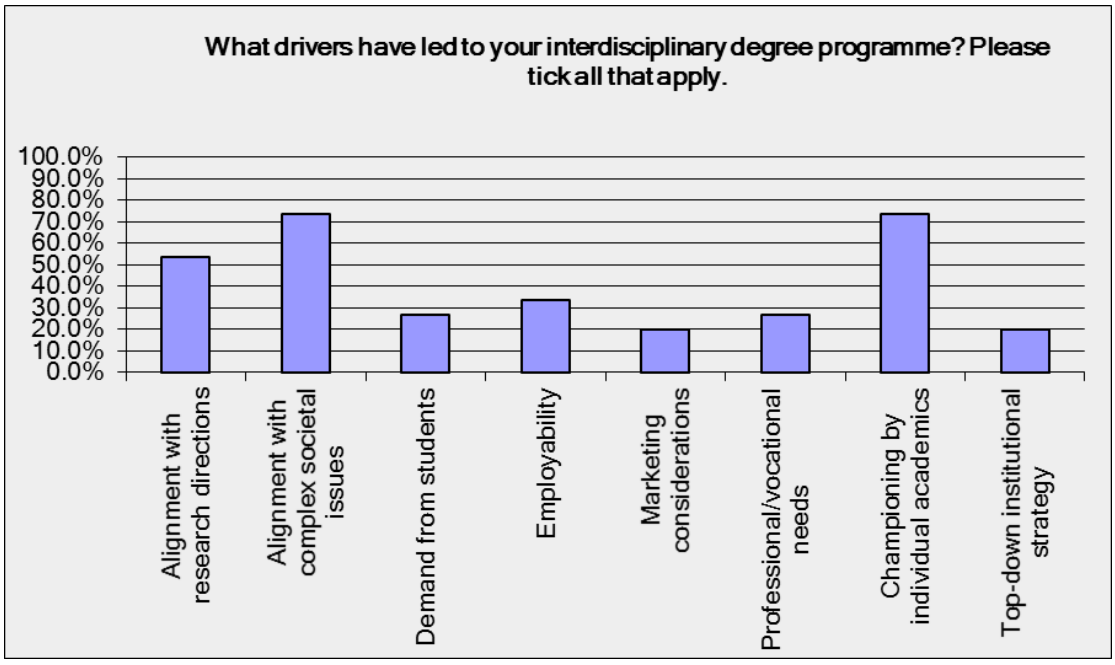


Chart 7: Drivers of interdisciplinarity (full dataset *n* = 112)

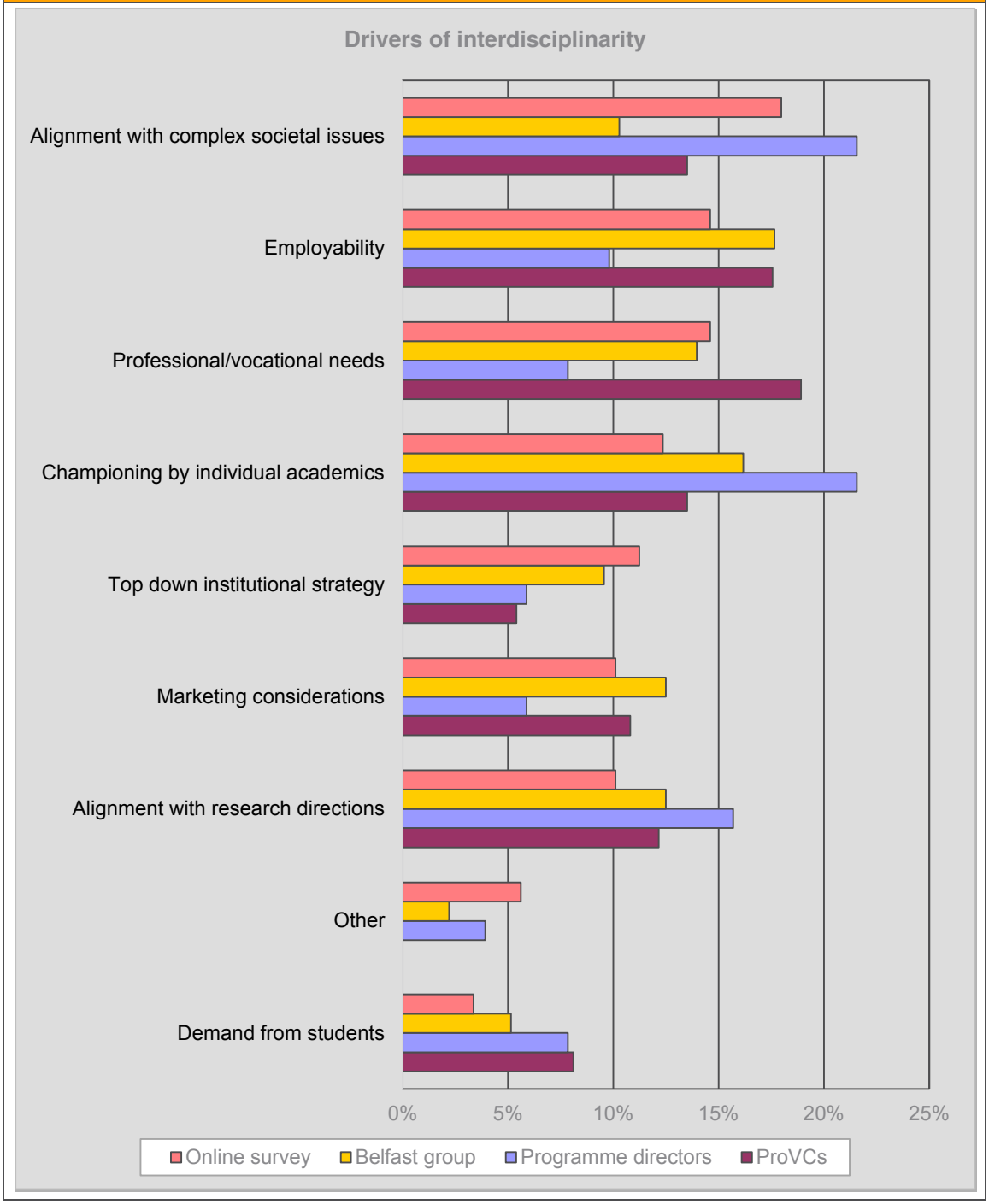


Chart 8: Scope of interdisciplinary provision, as seen by PVCs

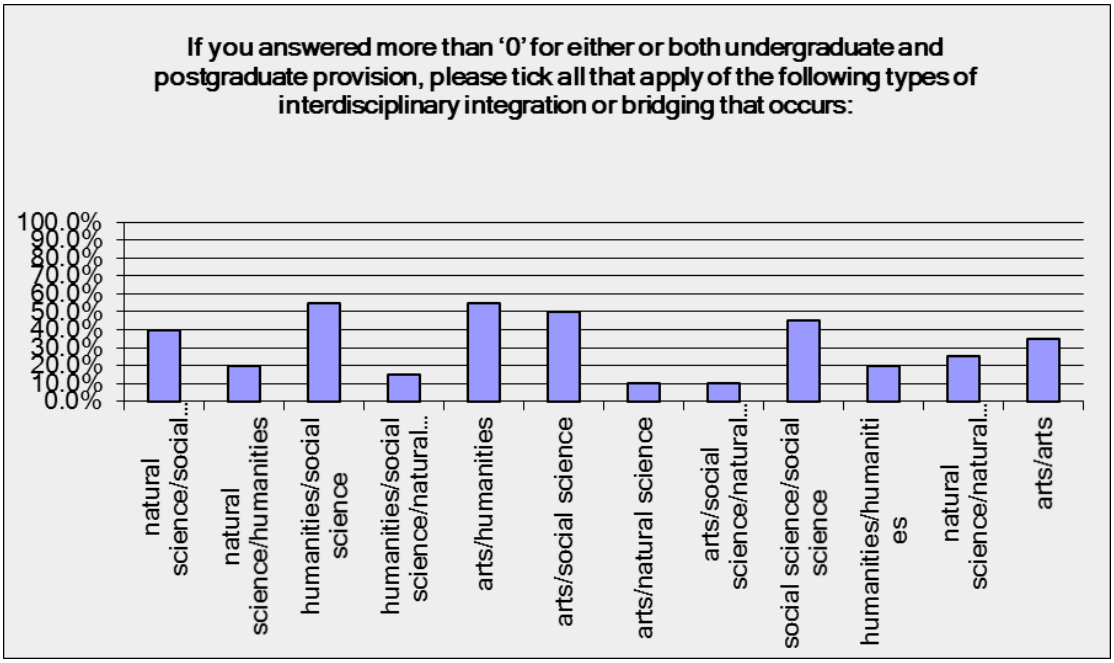


Chart 9: Integration through only one or two new modules, as seen by programme directors

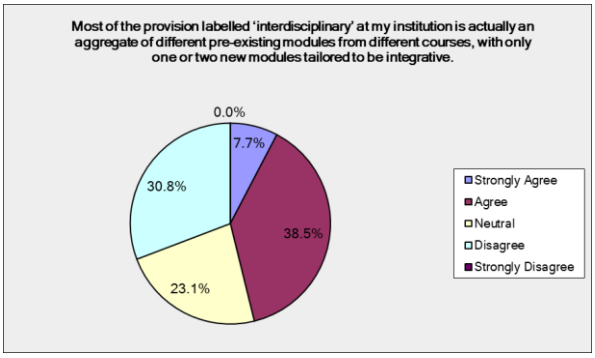


Chart 10: Integration through only one or two new modules, as seen by programme directors

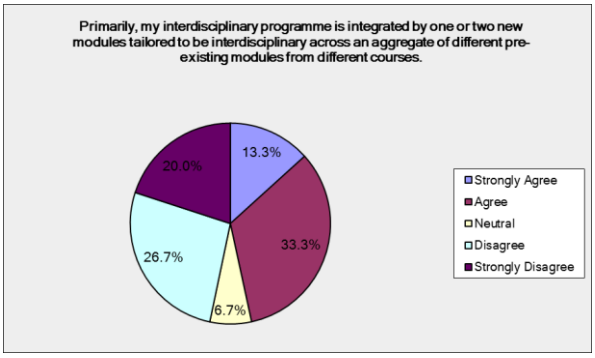


Chart 11: Degree of joint teaching as seen by programme directors

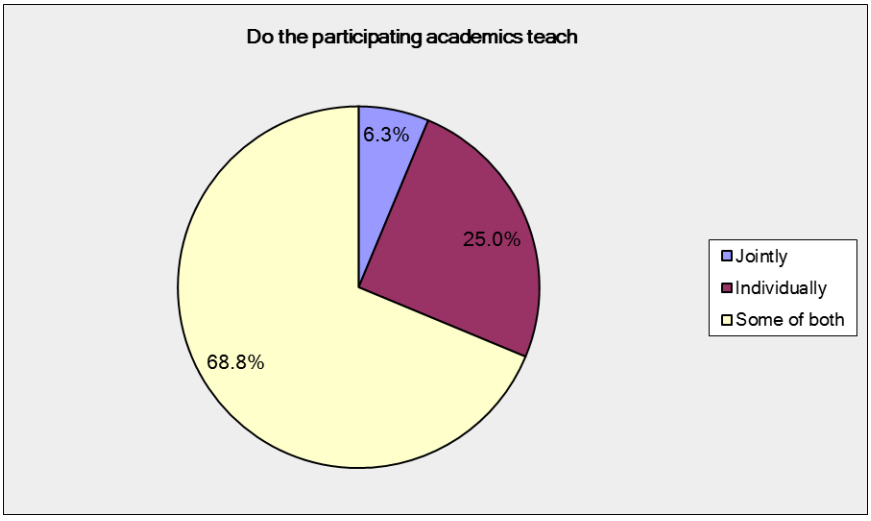


Chart 12: Manifestation of interdisciplinarity as seen by programme directors

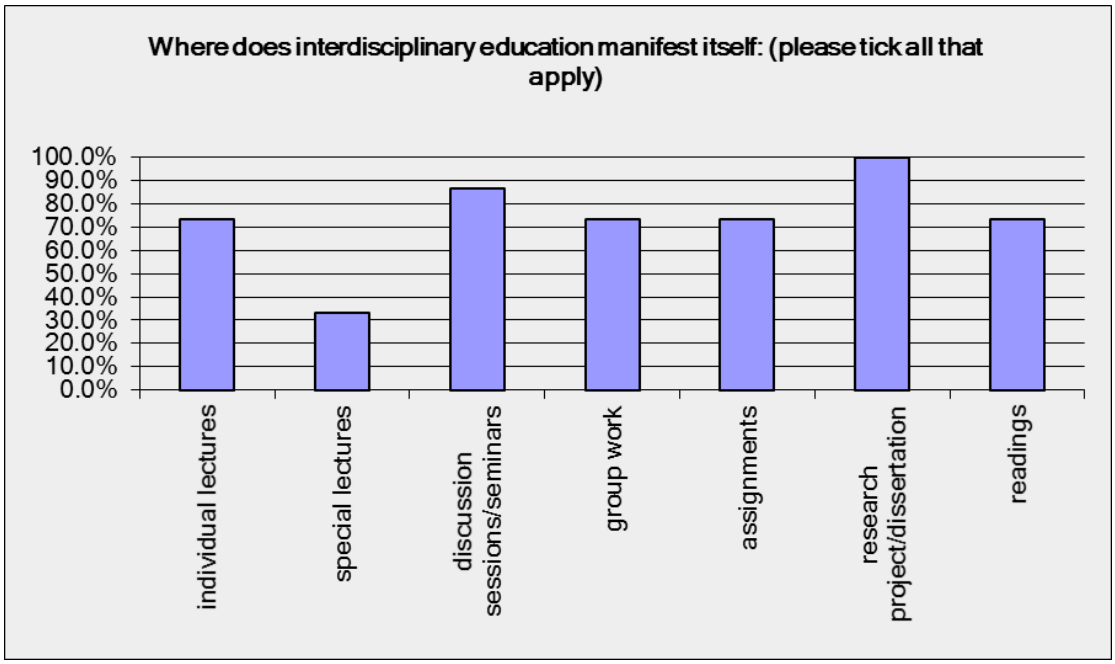


Chart 13: Use of innovative pedagogical methods as seen by programme directors

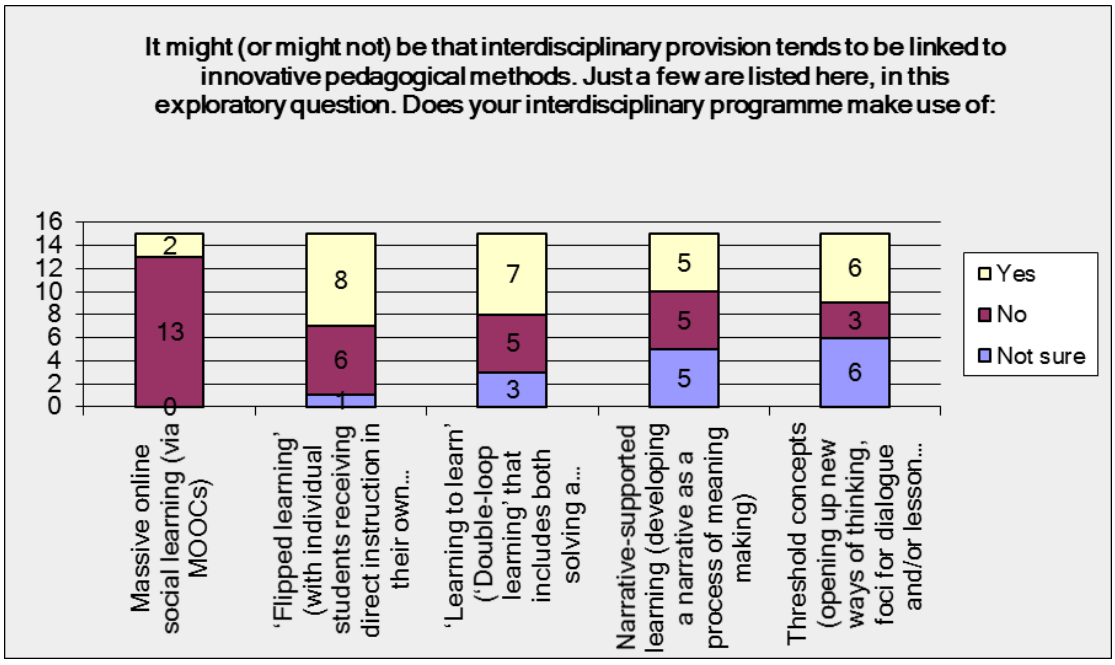


Chart 14: Likelihood of institutional reward as seen by programme directors

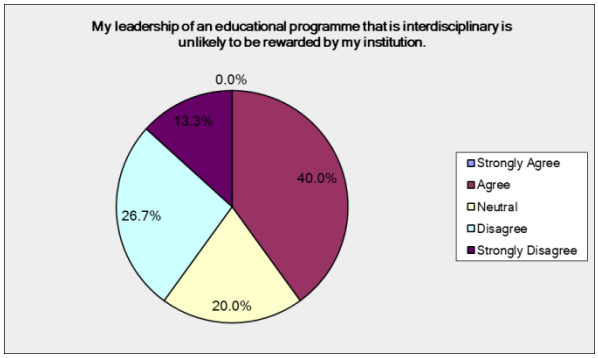


Chart 15: Trends over past five years (full dataset, *n* = 112)

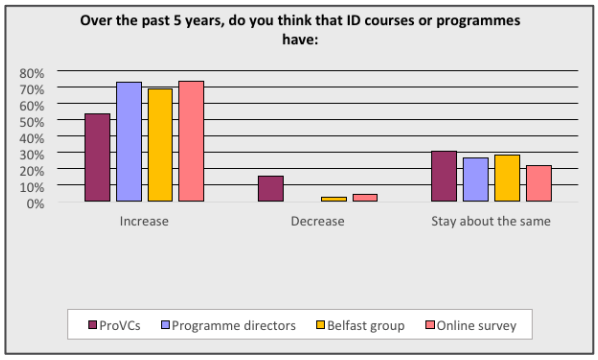


Chart 16: Trends in next five years (full dataset, *n* = 112)

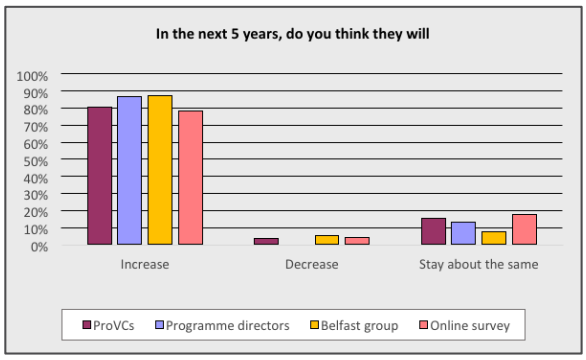


Chart 17: Expected level of interdisciplinary educational provision, as seen by PVCs

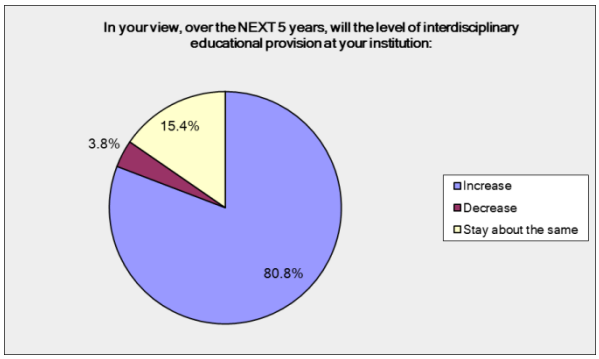


Chart 18: Expected proportionality of interdisciplinary undergraduate provision as seen by PVCs

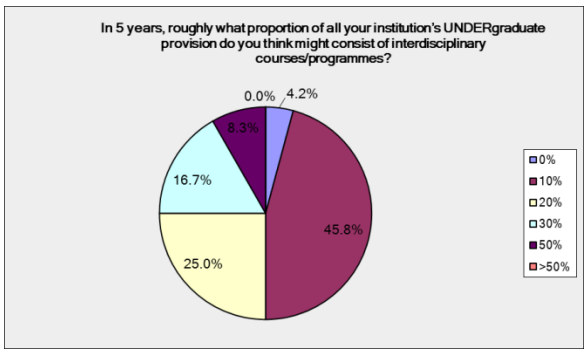


Chart 19: Expected proportionality of interdisciplinary undergraduate provision as seen by programme directors

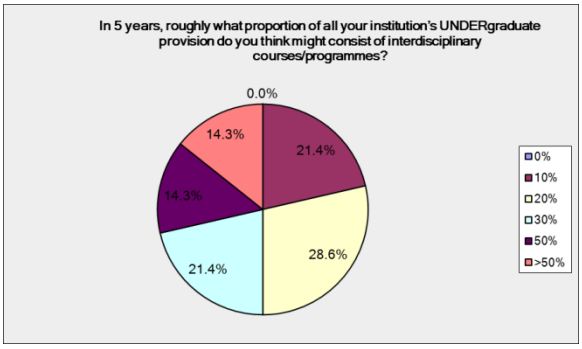


Chart 20: Expected proportionality of interdisciplinary postgraduate provision as seen by PVCs

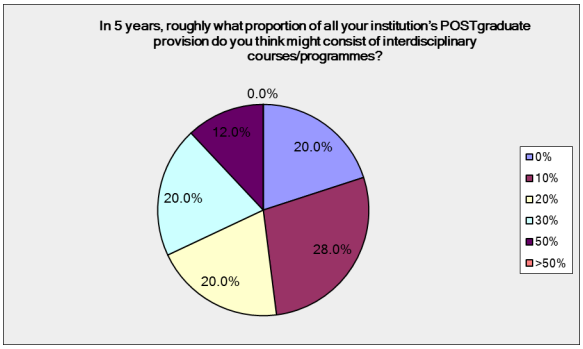


Chart 21: Expected proportionality of interdisciplinary postgraduate provision as seen by programme directors

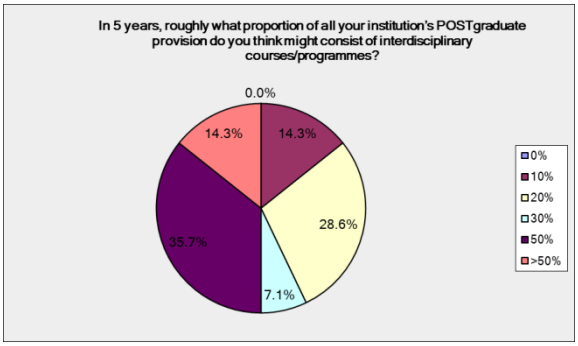


Chart 22: Expected contexts for interdisciplinary offerings as seen by PVCs

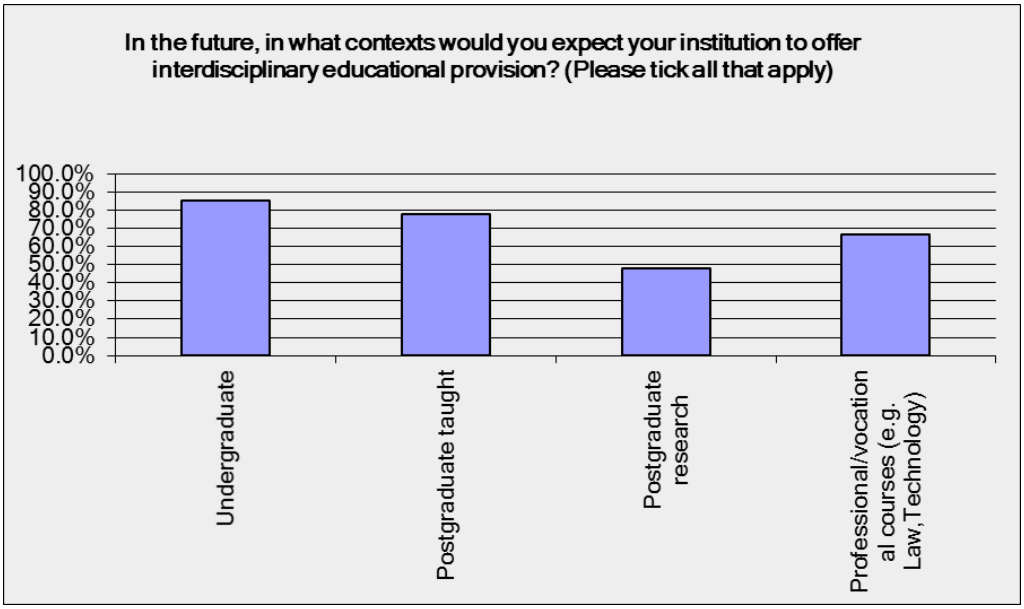
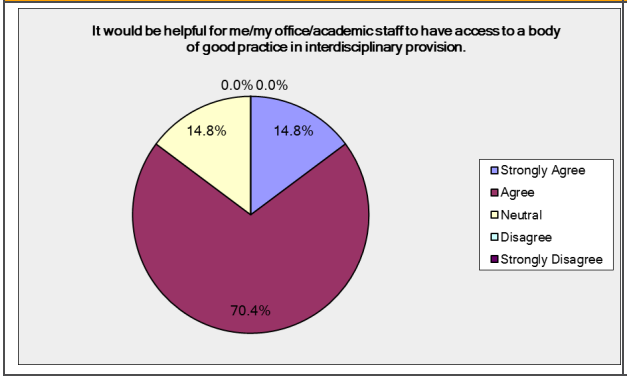
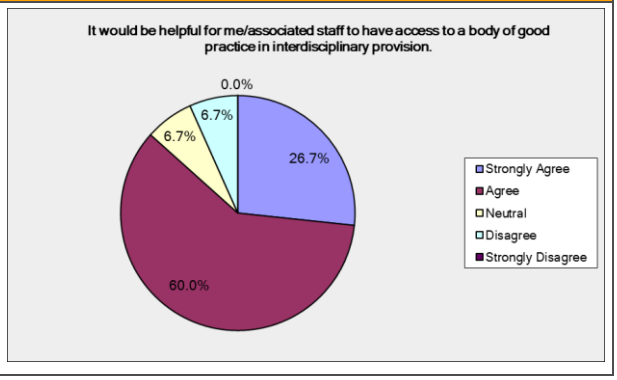


Chart 23: Expected contexts for interdisciplinary offerings as seen by programme directors

Chart 24: Desirability of access to good practice as seen by PVCs	Chart 25: Desirability of access to good practice as seen by programme directors
	

F. Lessons learned

As summarised in Section 4, survey respondents and interviewees were asked to share 'lessons learned' through their experiences with interdisciplinary provision, to help others hoping to develop an interdisciplinary programme.

University structures/politics/administration as seen by PVCs

- identify champions that stay with the development and the programme;
- ensure full and transparent consultation from the outset;
- it will take time and lots of consultation will be needed;
- talk it through at length with staff and students before writing the programme;
- establish and maintain effective communication across discipline teams agree a strategy and an approach for programme development;
- cultivate support at Dean level;
- to some, interdisciplinary programmes represent an unwelcome challenge to well-established structural and disciplinary norms. Be prepared to engage the sceptics with evidence (i.e. particularly student demand);
- get the core right first, ensure adequate resource availability beforehand, check out the competition;
- extensive market research and wariness about conversion rates from this;
- make it financially desirable to offer interdisciplinary education and get buy-in from the VC;
- organisation is complex. Aligning timetables and managing student choice adds to the complexity, aligning validation/approval helps;
- look at financial structures and administrative structures/boundaries to ensure they facilitate this;
- timetabling and scheduling process need to be amended. First tier assessment panels are uni-disciplinary so organisation across departments and course teams is essential;
- the credit architecture across the institution must be harmonised if different disciplines are going to work together with any ease. Programme validation must also be rationalised and those involved in validation need a solid grounding to understand the interdisciplinary aims of new programmes.

University structures/politics/administration as seen by programme directors

- plan well ahead and have informal discussions with colleges, etc. before approval processes;
- get it into workload models (particularly your own) before you start (and before the time taken to build and run a programme in your 'spare time' means you don't go out for two years) … that is, institutional buy in;
- get everyone on board early and ensure that content drives the modules and learning engagements not marketing;
- try to be patient, and work with a person who shares your interest;
- start working from the persons you have;
- be subversive. Take the view that if something is not explicitly ruled out, it is ruled in. Do not ask "Is this possible?" – it is too easy for people to say "no";
- do not expect others to understand or support your vision – they will see your stuff as an add on – even if they support they will not want to change their culture to accommodate – it will be business as usual and you will have to make the accommodations to join them. Be prepared for hard work;
- if senior management is not interested, the penalties for engaging in such programmes can be high.

Good practice and/or pedagogical methods as seen by PVCs

- stimulating pedagogical approaches and learning that can be derived from interdisciplinary practice;
- it can open people's eyes to a problem from a different perspective;
- you are by definition not teaching experts and need to tailor delivery;
- ensure contextualisation to prevent student dissatisfaction;
- making sure that the degree is truly interdisciplinary, and that there is space within the curriculum at every level to draw together understandings from across the disciplines;
- all components are equally excellent;
- managing collaboration;
- need for close working and excellent communication. Importance of course leader who works across disciplines;
- importance of regular team meetings and management discussions;
- getting engagement from all academic staff who deliver. It is no good having people who do not support and promote the concept … within the delivery team or students see it as something separate from the rest of their course;
- being aware of the different pedagogies used in the different disciplines – particularly from a perspective of language … It is important not to denigrate the practices of a different discipline and to come to a common language when speaking about pedagogies;
- be prepared to learn more yourself, on a continuing basis, and be prepared for things not to work as planned;
- adoption of a project board with representatives of all interested parties;
- dialogue with stakeholders.

Good practice and/or pedagogical methods as seen by programme directors

- it is you as a charismatic person or individual who will hold it all together and make sense of it for the students pedagogically – you are the lynch pin – the translational force;
- being confident to argue your corner;
- staff engagement is necessary to think through the pedagogical challenges of integrating different disciplines;
- our interdisciplinarity really began to gel when we had a joint academic project … the project forced us to work together in ways that we had not really done before, even in putting the programme together. It ensured that science and humanities expertise genuinely combined and we understood much more about each other's practice, which I don't think we had fully done in putting the programme together. It meant that there was genuine academic thought about the interdisciplinary subject, not simply addressing QA issues and programme management;
- bring in the subject experts when needed;
- be well planned and introduce interdisciplinarity to students (as generally single field learners) in graduated steps to keep them situated in the learning moment;
- engage students as much as possible (seminar, project, group work …);
- the flipped classroom is valuable;
- be especially flexible and imaginative about assessment.

Good practice and/or pedagogical methods offered by Belfast conference participant respondents

- teaching interdisciplinary courses can be confusing for participants in terms of challenging disciplinary assumptions;
- (it is) easy to bolt together modules to make an interdisciplinary programme (sort of!) but preparing truly interdisciplinary modules to form a truly interdisciplinary programme is harder because staff time is limited;
- communication + regular meetings to discuss joint areas + work. Team building. Designing all the modules together to link topics + make the links obvious;

- the importance of trying to break out of silos to set an example of interdisciplinary working from top-down. Creating an identity or sense of belonging for participants is key;
- make sure students understand interdisciplinarity and why they are looking at something from different points of view before you start;
- key is development of modules on the 'fault line' that support students in acquiring information, understanding different research methods. Students require scaffolding in 'joining up the dots' to make connections between disciplines;
- practical student engagement, interdisciplinary courses cannot be learnt through traditional approaches;
- inviting guest lecturers to share experiences in interdisciplinarity. Involving students in student assessment;
- use guest speakers from outside discipline, but only where material is carefully supported and embedded in related learning activities.
- had some very positive outcomes by investing in work with students around teambuilding, breaking down barriers to enhance learning;
- working with academics across disciplines has actually after initial sessions proven very positive in developing shared understanding and practices;
- be open to students' perspectives. Students from disciplines other than my own can bring new (to me) ideas = rich and complex discussion.

Guiding principles to underpin high-quality interdisciplinary provision as seen by PVCs

- make sure that it has a purpose. Interdisciplinarity for its own sake is less likely to work;
- it is not made up of bolted together modules, but a distinct offering;
- it must be a meaningful integration, not paying lip service;
- always include some integrated interdisciplinary aspects to such provision; don't allow programmes/modules which are just disciplinary siloes;
- strong programme teams to ensure a joined up approach to curriculum planning;
- keep it VERY simple;
- excellent communication and agreed, clear and transparent goals;
- strong teams; good communication; excellent planning;
- effective joint planning and development of programmes;
- assessment loading and assessment requirements need to be agreed across disciplines;
- consultation;
- student-focused and research-led;
- equality;
- one discipline is not more important than the rest;
- do not think you know best what interdisciplinary means (i.e. YOUR discipline is not necessarily the apt starting point…).

Guiding principles to underpin high-quality interdisciplinary provision as seen by programme directors

- stick to your vision;
- continual dialogue with colleagues;
- have key people involved who are enthusiastic-sort out governance and financial streams (!!!);
- get it into workload models;
- it needs senior management buy-in. If the institution supports and rewards interdisciplinary co-operation, there's almost always people who want to work on making it happen;
- questioning through synthesis – 'always connect'/ compare/contrast/intervene;
- do not leave it to the students to provide the synthesis;
- accept that students coming from different background brings a lot of diversity and richness to the programme;
- I am not sure there is one (guiding principle). I can only imagine that different combinations require different guiding principles. But if there is one, I'd love to know it!

Key lessons offered by interviewees

- commitment at the top of an institution, combined with an entrepreneurial champion are key to making interdisciplinary programmes happen;
- everyone can be happy with interdisciplinarity as an additional learning opportunity, without having to make the commitment of change within their structure. But these learning spaces need to be managed so that they do not become 'toxic' by being treated as a dumping ground for things people do not want to manage in their faculty structures;
- build in orthodox QA procedures, notwithstanding the extra workload it creates; you get an academic credibility that would otherwise be difficult to attain. Without that, you are open to attack from academics;
- spend a lot of time building friendships;
- you need to speak in multiple voices: with colleagues – you emphasise intellectual aspects, not employability; when talking to senior management – you discuss 'how we can attract better and more students' and 'employability'; when talking to outside stakeholders – you discuss 'employability' … These projects always have multiple drivers, you have to juggle as best you can;
- to get attention as successful, interdisciplinary provision would need to show increased applications/numbers, enhanced student satisfaction, student retention and employability - the key performance indicators of education. (However, because these are complex measures, it could be hard to say that they are due exclusively to the fact that a programme is interdisciplinary.)
- if you have a reasonable number of students, you cannot manage it 'around the edges' with people volunteering; you have to have staff;
- ensure that academics' involvement is not in addition to their workload but is part of their workload. As soon as it is acknowledged that interdisciplinary teaching is not something you do as a favour, it frees up academics to take it seriously … The university shows its support … It is really important that people know they are not doing interdisciplinary teaching over and above what they are already doing, because they do not have time anyway. (Teaching buyouts can be a huge boost to interdisciplinarity.)
- when a range of academics from different backgrounds work together on an interdisciplinary course, a spirit of collegiality and a thick skin (since colleagues will critique each other) are very good for both the individual academic and the quality of the course and its materials;
- There are different meanings for interdisciplinarity; any individual's interdisciplinarity can be unique. You need a very flexible set of structures to do justice to all of those.

G. Survey instruments

a) Shorter online surveys
b) Survey for PVCs
c) Survey for programme directors

a) The survey instruments for the short online surveys and the survey administered at the Belfast enhancement event were based on the following subset of questions from the main surveys:

Interdisciplinary provision in higher education: current and future challenges

Professor Catherine Lyall, University of Edinburgh c.lyall@ed.ac.uk

Please help us with the fieldwork for our HEA study!

We are currently conducting a study for the Higher Education Academy to investigate interdisciplinary educational provision in UK higher education (see https://www.heacademy.ac.uk/project/10355 *for details).*

This online survey has eight questions (five check boxes and three short text responses) and should take 5-10 minutes to complete).

1. Over the past five years, do you think that ID courses or programmes (not single modules) have:

   ☐ increased ☐ decreased ☐ stayed about the same? (please tick)
2. In the next five years, do you think they will:

   ☐ increase ☐ decrease ☐ stay about the same? (please tick)
3. *Approximately*, how many ID courses does your institution offer? (please tick):

   Undergraduate: ☐ None ☐ 1-2 ☐ 3-5 ☐ 6-10 ☐ >10 ☐ Don't know

   Taught PG: ☐ None ☐ 1-2 ☐ 3-5 ☐ 6-10 ☐ >10 ☐ Don't know
4. Do you work for:

   ☐ a UK university ☐ another UK institution ☐ a non-UK based organisation?

5. What has encouraged development of interdisciplinary degree programmes at your institution? (Please tick all that apply)

   ☐ Alignment with research directions

   ☐ Alignment with complex societal issues

   ☐ Demand from students

   ☐ Employability

   ☐ Marketing considerations

   ☐ Professional/vocational needs

   ☐ Championing by individual academics

   ☐ Top down institutional strategy

   ☐ Something else (please explain briefly):

6. If you were now to think a bit more about the big issues for ID educational provision, what are the key obstacles and drivers:
   - what is encouraging and supporting you?
   - what is hindering you or holding you back?

7. If you have developed some ID courses yourself (or are perhaps starting to do so), do you have any lessons that you would like to share on effective pedagogical methods/practices?

8. Finally, what staff development support might be required to do this more effectively?

Thank you for your help. If you would like to continue the conversation please include your contact details:

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Email:

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